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THE INFLUENCE OF INDIVIDUAL DIFFERENCES IN LEARNING AND MOTIVATION ON THE PERFORMANCE OF STUDENTS IN RAAF PILOTS' COURSE

THESIS

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THE INFLUENCE OF INDIVIDUAL DIFFERENCES IN LEARNING AND MOTIVATION ON THE PERFORMANCE OF STUDENTS IN RAAF PILOTS' COURSES

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

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In Partial Fulfilment of the

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Master of Science in Logistics Management

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Wing Commander, Royal Australian Air Force

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Preface

In undertaking this thesis initially, I hoped to accomplish two objectives. One was to fulfil the requirements for the award of a Master of Science, the other was to contribute something to the success of future students of RAAF Pilots' courses. During the process other things happened. I have been enlightened about measurement in the social sciences. I have also gained an appreciation for the power of research as an aid to management practice.

I have many people to thank for my educational experience. In particular, I wish to acknowledge the work of Wing Commander Graham Rowe, upon whose work I built. In Australia, I relied on Mr Stan Bongers, Director of Psychology - RAAF, and his psychologists in Melbourne and Perth for the collection of data. I wish to thank Professor Ross Telfer, of the University of Newcastle, for his assistance also.

At the Air Force Institute of Technology I was assisted by many faculty members. In particular, I would like to thank Dr Robert Steel for both his lectures and his assistance so freely given. My advisor for this task, Lt Col James Lindsey, deserves most of whatever credit comes from the effort. I will be eternally grateful for his advice, rigor and attention to detail.

Finally, I thank my family who supported me in so many

ways. My wife, [redacted] children [redacted] have been exceptionally patient during the long gestation period.

Terry Connolly

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Abstract

This study had two objectives:

1. to develop a valid instrument to measure the learning and motivation of students in pilot training for the Royal Australian Air Force; and

2. to test the hypothesis that students of a certain ability level would achieve a level of performance dependent on their learning experiences and their motivation.

A survey of all students on course was conducted in late March - early April 1988. Scales were developed to measure variables related to the quality of instruction and the level of motivation reported by the students. The scales appeared to validly discriminate among students on a basis of age and position in the training pipeline.

Aptitude test scores and relevant biographical data (eg. number of hours in powered aircraft prior to the course) were collected to provide an independent measure of ability. Finally, a measure of performance was collected for as many students as possible. The hypothesis was tested by investigating the nature of relationships between the predictor variables and the performance measure. Unfortunately, the hypothesis was not proven.

Although this research did not explicitly specify the relationships between ability, instruction, motivation, and performance, it did indicate the potential of some variables to explain part of the variance in student performance in

pilot training. Directions for future research were recommended.

THE INFLUENCE OF INDIVIDUAL DIFFERENCES

IN LEARNING AND MOTIVATION

ON THE PERFORMANCE OF STUDENTS IN RAAF PILOTS' COURSES

I. Introduction

Background

By USAF standards the Royal Australian Air Force (RAAF) is a small force. With approximately 22,000 personnel in uniform, the RAAF is currently operating two strike/reconnaissance squadrons, four fighter/ground attack squadrons, two long range maritime patrol squadrons, three fixed-wing transport squadrons, one medium-lift helicopter squadron, a composite squadron of fixed- and rotary-wing tactical transport and two tactical rotary-wing squadrons. The size, capital equipment and operating budget of the force are a function of the Australian Government's view of Australia's present defence interests.

Under normal circumstances, the RAAF needs approximately 65 new pilots a year to match the attrition rate of experienced pilots through promotion, resignation and other causes. However, this number can vary dramatically. The Chief of the Defence Force (CDF), in a recent message quoted the following figures for the whole defence force:

Pilot wastage had risen from 47 per annum to 65 in 84/85, 70 in 85/86, 107 in 86/87 and to date (July 87 to January 88) the 87/88 figure is already 111 (6).

As RAAF pilots make up the bulk of the pilots in the Defence Force these fluctuations have a noticeable impact on the RAAF's capabilities. The impact is particularly severe in the flying training area since a relatively large proportion of those leaving are instructors. The RAAF faces the dual problem of needing to increase the throughput of trainee pilots to match attrition, yet do so with a shrinking number of instructors.

In this light, the success rate achieved by students on the RAAF's pilot training course has become more critical. Historically the RAAF student pilot success rate has been approximately 50 percent when measured over the total course(24). With a 50 percent success rate, the number of students who start the course each year has to be about twice the number of pilots predicted to leave flying duties the following year, just to continue RAAF operations at existing rates. If the number of pilots required rises sharply, as is the present case, the training pipeline attracts the attention of the highest command levels of the RAAF.

The RAAF's pilot manning problem could be alleviated by improving the retention rate of experienced pilots and/or by improving the success rate of student pilots. Defence Force commanders have taken steps to deal with the first issue. This paper focuses on the latter one. Interest in the area

is not new. Indeed both Headquarters Support Command, the command responsible for conducting pilot training, and Air Force Office have reviewed the pilot's course a number of times (eg.19 & 38).

These staff reviews have generally taken a macro view of the RAAF pilot training system. Today's system reflects their efforts.

Individual Differences

In contrast, this research adopted a micro view of the pilot training system. The unit of analysis for the study was the individual student. Each one remains a unique entity even though he or she has passed through a rigorous selection process designed to identify and eliminate those, in the general population, who would not succeed on the course. Despite the rigorous selection procedure though, there is still a range of abilities or competencies amongst the students starting the pilot training course. These differences in abilities can be ascribed to differences in intelligence, physical attributes, or experience.

The concept of intelligence is a very complex one and is used here merely to highlight the uniqueness of each student. Psychologists approach the concept in a number of different ways; some are interested in the behaviour that results from intelligence and others in the process by which the intellect is used (3:381-382;20:267-270). For this paper intelligence means a measure of global cognitive ability or skill.

Individual differences can also be thought of as variance in the style of cognition; or the various ways individuals perceive the world, conceptualise meanings, learn tasks or solve problems (3:383). Differences in cognitive style could impact on the matching of instructors to students, for example. At present matching instructors to students is done on a random basis. The initial allocation of students to instructors is often done without the benefit of information on individual students. Students take some time to display strengths and weaknesses, as well as likes and dislikes. A flight commander eventually aims to match students to instructors using ability and personality criteria but he is limited by time, the number of and the experience level of available instructors, and other administrative constraints.

Although students starting the course have, at least, the minimum aptitude to be given training; they each start the course with a unique set of abilities already mastered. The aptitude measurement attempts to identify limits on the range of abilities an individual can acquire through learning but it is possibly contaminated by relevant skills an individual already has. Many skills, already attained, are directly transferable to the course and could explain some of the variance in the degree of difficulty experienced by students.

Another difference among students is their immediate pre-course experience. Students for the course come from the following sources:

1. Direct Entry. Civilians may be recruited specifically for pilot training.

2. The Defence Force Academy. Civilians with suitable academic qualifications are recruited to complete an undergraduate degree at the Defence Force Academy, Canberra, before commencing the pilot's course.

3. Serving Airmen. Suitable RAAF airmen and airwomen are eligible to undertake pilot training on application.

4. Serving Officers. Officers of any category are able to apply for pilot training. General Duties Navigators and Engineering Officers are given preference.

Direct entry civilians, and serving airmen and airwomen, have to complete a 12 week officer training course before commencing their pilot's course and a very small number of pilot candidates are eliminated during this officer training course. Remaining students have different pre-course experiences.

All these factors combine to ensure variability among the students and are likely to be significant contributors to the final outcome of training for individual students. On the course individuals continue to have unique experiences and reactions to the various stimuli they receive. By taking the individual as the unit of analysis, rather than looking

at the system as a whole, the author attempted to find relationships between variables, which were thought to influence the performance of individuals, and their end of course results. The reason for this approach was that any variable found to have a significant effect on student performance would be brought to the attention of training managers, who could manipulate it to improve the chance of success for individual students.

The Course

The RAAF pilot training system produces pilots with a common graduation standard. There are no distinctions made between students on a basis of post graduation employment. Graduates are picked for their operational role through a combination of ability, preference and posting availability. Once assigned to an operational squadron, graduates are given further specialised training before they take up the role of a squadron pilot.

Pilot training is conducted in five phases, each approximately three months long, in two widely separated Schools. Basic flight training, the first two phases, takes place at No. 1 Flying Training School (1FTS), RAAF Point Cook, near Melbourne on the south east coast of Australia. In Phases 1 and 2 the students learn to fly a piston-engined, propeller-driven aircraft with side-by-side seating (the Airtrainer CT-4). Students complete about 65 hours flying at 1FTS.

No. 2 Flying Training School (2FTS) at RAAF Pearce, near Perth on the south west coast of Australia, conducts the remaining three phases, or advanced flight training. In these phases the student learns to operate a medium performance single engined jet with tandem seating (the Macchi MB326H). Students fly approximately 150 hours on the Macchi.

From experience as a student and an instructor at both schools, the author expected students to perceive the two schools as being quite different. Students at 1FTS are treated differently to students at 2FTS. An underlying assumption among staff at 1FTS is that the typical student knows little about flying. Therefore, for safety reasons, 1FTS is more "rule orientated" than 2FTS. At 2FTS, staff expect a student to show initiative, both while flying and on the ground, consequently more room is allowed for judgement by the students.

Another important difference between the schools is the success rate achieved. The success rate at 1FTS is smaller than 2FTS, as would be expected since 1FTS acts as a screen for 2FTS. For example, between No. 99 Course and No. 122 Course, courses trained on the same aircraft type and with the same syllabus as today, the percentage of those starting 1FTS who graduated to 2FTS was 75 percent. Of those students in the same courses, who started 2FTS, 85 percent graduated as pilots (19:Figure 4). Therefore, students at 2FTS

probably feel more confident that they will graduate as they see less attrition than students at 1FTS.

General Issue

Although previous RAAF studies have expressed concern about the apparently low success rate achieved by pilot trainees, not all those studies investigated the problem at an individual level of analysis. Professor Ross Telfer, of the Educational Faculty of Newcastle University, first looked at individuals with a survey of RAAF instructors and students in 1981 (36). His preliminary study gave the impetus for the Director of Psychology - Air Force, Mr Stan Bongers, to conduct the survey which was analysed by Wing Commander G. S. Rowe in 1987 (28).

The work by Bongers and Rowe was a definite attempt to improve the student pilot success rate by identifying factors which influenced students performance on course. In his analysis, Rowe did find a number of factors which he thought were likely to contribute to the success of a student on a RAAF pilot training course. He categorised the factors into three areas: learning, motivation and evaluation. Rowe sub-divided these categories as follows:

1. Learning.
    a. The standard of instruction.
    b. The methods of instruction.
    c. Learning practices employed by students.
    d. Instruction given to students on how to learn.

2. Motivation.

a. The level of student motivation.

b. The student/instructor relationship pervading.

c. Student understanding of training objectives.

d. The standard of living and working conditions.

3. Evaluation.

a. Feedback of results to students.

b. Conflict between preparation for ground school and preparation for flights (28:79).

Meanwhile, the success rate achieved by students remains at the historical level of about 50 percent, when measured as a percentage of those graduating with wings compared to those who start 1FTS.[1] The continued trend of suspending so many students is not only expensive and inefficient but is also exacerbating the RAAF's current shortage of pilots.

Research Objectives

The first objective of this research was to develop a valid instrument to measure the aspects of training which Wing Commander Rowe identified as being critical to a student's performance on pilots' course. These aspects were learning, motivation and evaluation.

The second objective was to test the hypothesis that individuals of a given ability level achieve a greater level

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[1]. Rowe reported the success rate for the eight courses before mid-1986 as approximately 64% (27:9). However, more recent figures show a return to approximately 50% success. (See Appendix A for details.)

of performance if they experience high levels of learning and motivation during the pilots' course and evaluation has a positive effect on them.

Research Questions

Out of these research objectives flowed the following specific questions:

1. Is the level of learning, motivation and evaluation experienced by individual students positively related to their success on RAAF pilot courses?

2. What other factors are likely to influence the success of students?

3. Can student performance, as measured by final course position, be predicted from the combination of measures available from aptitude tests and measures derived from the survey instrument?

4. What changes occur over the period of the training course in the level of learning, motivation and evaluation experienced by students?

5. What actions might be taken to improve the chances of success for individuals on pilots' courses?

Scope of the Research

This research investigated only some of the factors likely to influence the success of RAAF student pilots. Wing Commander Rowe developed an extensive prototype survey instrument in his research which sought to study many more

areas. One important area he would have investigated, which the author did not, was the measurement of difficulty experienced by students in doing specific flying sequences they face throughout the course. The author's view was that both this subject and other areas warrant a separate research effort.

This research, also, did not study the pre-pilot course training and experiences of the students. Variations in these areas could possibly be important in determining an individual's success. However, the collection of demographic data did allow discrimination with respect to some prior experiences.

II. Literature Review

Chapter Overview

The main aim of this research was to test the hypothesis that the performance of individual students on RAAF Pilots' course was affected by learning, motivation, and evaluation experiences they encountered during the course. This literature review reports on research done previously into RAAF Pilot training, pilot training in general, and into related educational areas. The review first examines the general aspects of education and training which have commonalities with pilot training before considering specific pilot training matters.

Learning Theories

In the context of an educational process, learning has been defined as the acquisition of a behaviour brought about deliberately, or not, by the learning environment (10:625). The learning environment in turn referred to the dynamics of the instructional setting with an emphasis on learning variables, such as the knowledge of results (feedback), massed or spaced practice (11:91). Learning was said to have taken place when a relatively permanent change of behaviour took place (11:92).

Conditioning. Some learning theorists treated humans as reacting organisms and were interested in the response of a human to stimuli in the environment. These theorists, who

could be classed as behaviourists, developed learning models in laboratory settings. Behaviourists maintained that a permanent change in behaviour could be accomplished by conditioning. At the most basic level was classical conditioning. Classical conditioning had its roots in the work of the Russian physiologist, Pavlov. The process began with an unconditioned response: Pavlov used the salivation response (unconditioned response) which occurs naturally in dogs when they are shown food (unconditioned stimulus). The next step was to condition the subject to give the same response (conditioned response) to a different stimulus (conditioned stimulus) which was associated in time with the unconditioned stimulus. Pavlov used a buzzer when about to present food to his subject dogs until the dogs eventually salivated at the sound of the buzzer without any food being presented. This particular behaviour had to be reinforced periodically or otherwise it extinguished or disappeared (3:143).

According to Biggs and Telfer, the classical conditioning model was most appropriate for emotional responses in humans (3:144). Skinner criticised it (he called it respondent conditioning) for explaining only a limited part of human learning: the reflexive behaviours (30:503). As Telfer and Biggs pointed out though it can be a useful model in flying training. They gave the example of an over anxious and timid student pilot who could be helped to

overcome this problem by ensuring he or she experienced other more favourable emotions during each flying lesson to build up a pleasurable association with flying instruction (35:96).

The other model of conditioning began with work into trial and error learning done in 1898 by Thorndike. Skinner's operant conditioning (30) was an extension of Thorndike's line of thinking. The model postulated that behaviour resulted in an outcome. The outcome could be pleasurable (rewarding), or not. If behaviour resulted in a pleasant end then it was more likely to be repeated in the future than a behaviour which resulted in an unpleasant consequence. The four processes by which behaviour was altered are listed below:

1. Positive Reinforcement. Positive reinforcement occurred when behaviour was rewarded and lead to a high likelihood of repetition of the behaviour.

2. Negative Reinforcement. Negative reinforcement arose when behaviour led to an avoidance of an unpleasant consequence and it also resulted in a high likelihood of repetition of the behaviour.

3. Extinction. Extinction happened when a positive reinforcement was removed (behaviour was ignored); it led to a lower probability of the behavior reoccurring.

4. Punishment. When behaviour was met with an externally administered sanction the probability that the behaviour would be repeated might reduce, but the

consequences of using punishment to alter behaviour were considered less predictable than extinction as a means of altering behaviour (3:148-155; 7:108).

The operant conditioning model has many educational applications. For instance, in a classroom setting, modifying undesirable behaviour in children can be achieved by rewarding those children who act in the desired way (by praise, or selection for special events desired by all children), while ignoring children who do not behave as desired. In this case, the reward is a form of positive reinforcement but starving children of attention is equivalent to withdrawing positive reinforcement and, theoretically, leads to extinction. This example is simplified and the reader is advised to study the references for a more extensive treatment (3:160-180; 11:94-107; 20:108-109).

Reinforcers could be externally administered, or they might be internally derived. In the world of flying training, an instructor can provide positive reinforcement by praising the student for correct actions. Negative reinforcement occurs for students who pass a retest and remove a cause of anxiety (anxiety is the negative reinforcer). Telfer warned, though, that a negative reinforcer could, unwittingly, be a source of classical conditioning in the form of unpleasant emotional associations (35:97). Extinction can only be practised by an instructor

when safety is not prejudiced. Punishment, including sarcasm and even physical punishment, may have a place in flying training but unwanted further effects (e.g., resentment) could be induced when punishment is administered (3:152-155). Unfortunately, students may also derive reinforcement from internal sources (e.g., their feelings of success or failure) which may conflict with the instructor's strategy.

Cognition. Behaviourists focused on responses to the environment, treating the human mind like a black box. Another class of theorists have attempted to explain human learning in terms of internal processes. These theorists are concerned about the mental activity which accompanies learning. They believed that learning comes from thinking rationally about a problem, from induction and deduction. Mussen et al said that the concept of cognition referred to "the mental activities involved in the acquisition, processing, orqanization (sic), and use of knowledge (20:219)." Theories of cognition assumed an individual was goal-oriented, or motivated to learn. The major mechanisms of learning in Piaget's cognitive model, as described in Mussen et al, are listed below:

1. Assimilation. Assimilation was described as the mental process by which new ideas or objects were interpreted in terms of ideas or actions an individual had already learned.

2. Accommodation. When a new object or idea could not be assimilated because there was no obvious link to past learning an individual went through a modification process called accommodation. Accommodation could involve a restructuring of concepts previously held as true to "accommodate" the new fact.

3. Equilibration. An individual was assumed to seek a state of equilibrium , or cognitive harmony, where the environment was fully assimilated or had been accommodated. When current structures no longer explained away the environment an individual was said to be out of equilibrium and would seek to accommodate by changing his, or her, understanding of the world (20:224-225).

The application of cognitive models to flying training suggests that, for best learning and retention, the instructor should upset the student's equilibrium. Telfer and Biggs suggested four strategies to do this:

1. Surprise. Present new ideas or techniques unannounced.

2. Perplexity. Ask questions which require synthesis of previous material, induction or deduction.

3. Bafflement. Ask questions which can not be answered by the student at his or her current stage of learning.

4. Contradiction. Present new ideas or skills as a contradiction to what is known (35:101).

All of these approaches put the student in a position of disequilibrium which the model asserted would cause assimilation or accommodation to occur. Unfortunately, the difference between the known and the unknown which most motivated learning varied for each individual. Differences in many of the commonly used personality constructs, for example flexible versus rigid, high need-achiever versus low need-achiever and introvert versus extrovert, influenced the ideal degree of mismatch (3:194).

Conditions of Learning

The models of learning could be used to give instructors an insight into the range of ways in which a student learns. No one model explained every learning situation but each had application to some aspect of flying training. The degree of learning which took place in the training environment was also of vital concern to the instructors. Goldstein believed that the degree of learning was a function of the preconditions of learning and the conditions of practice (11:112).

Preconditions of Learning. The preconditions of learning referred to the learners' readiness to learn, that is the level of maturation and the experiences of the individual, and the learners' level of motivation. In the RAAF selection process an individual's readiness to learn was predicted by results in aptitude tests and interviews (14). However, the author remembers students who were classified by

the Commanding Officer (CO) of No 1 Flying Training School, as being too immature to do the course, after they were suspended for failures in air work. Whether the CO's judgement was wrong or right, readiness to learn appears likely to be an important variable in determining success in a pilot training course.

Motivation. Motivation was thought of as a driving force or level of energy to act in a certain way. Most human behaviour theorists maintain that the level of motivation influences the level of performance. For this reason motivation has been the subject of a great deal of research. Theories of motivation have been divided into two categories: process theories and content theories. Process theories describe the way in which motivation affects performance. Content theories describe the individual or environmental factors which cause performance to occur (11:113). Rowe reviewed the theories of Maslow and Vroom in his work and he discussed the application of reinforcement theory to motivation, therefore those theories have not been repeated here (28:24-25).

Goal-Setting. Another important application of motivation theory to the training setting was goal-setting. Locke found that a "harder" goal led to a higher level of performance than did an "easier" one (17:120; 18:326). A Locke and Bryan experiment indicated clearly that a specific goal resulted in better performance than did an exhortation

to "do your best" (17:129). Locke reported that even when the probability of reaching the harder goal was less than 10%, this goal produced higher output than did goals which were easier to reach (17:120). For training situations, this relationship was restated as: the higher the performance desired, the more specific must be the objectives of the training (11:117).

Conditions of Practice. Conditions of practice referred to the situation under which behaviour was learned. Goldstein (11:120-127) listed six important variables:

1. Whole Versus Part Learning. Some complex tasks were more easily learned if the whole task was broken into smaller components and each component was practised separately (11:120-121). For example, in flying training students should be taught elements of the circuit individually before all are combined into the student's first attempt at a complete circuit.

2. Massed Versus Spaced Practice. There was no "best" strategy for practising a newly learned skill. Although distributed practice, with adequate rest periods, was often favoured in research findings, when students were likely to forget critical responses, or the error rate was likely to be high, rest periods have been shortened or eliminated to get the best results (11:121-123). Therefore, a student pilot might benefit from the repetition of a new task which requires a complex sequence of steps, despite the fatigue

generated. Obviously though a point is reached when learning stops if this process is taken too far.

3. Overlearning. Overlearning, or rote learning, was defined as rehearsal of material or skills at least as many times again as needed for perfect recall (3:118). Overlearning freed space in working memory, allowing performance to be maintained in periods of emergency or stress and was therefore very appropriate to cockpit checks and emergency procedures for pilots (34:80).

4. Knowledge of Results. Knowledge of results, or feedback, has long been known to affect learning. Biggs and Telfer stated simply: ". . . all learning must have feedback (3:177)." Locke's study revealed that knowledge of results improved performance by operating on motivation as a form of reinforcement as well as giving information to the subject which was useful in the pursuit of goals (18:328). However, Daft and Steers made the point that no simple feedback-performance relationship existed. Individual differences in achievement needs caused different reactions to feedback (7:113). Personality type, e.g., introvert versus extrovert, was also related to a subject's response to knowledge of results (3:177). Despite the variability of response to feedback though, Biggs and Telfer concluded that some feedback was better than none (3:118).

5. Retention. A number of factors determined the degree of retention of learning over time. Goldstein

postulated that retention of new material was a function of the degree of original learning, the meaningfulness of the material, and the amount of interference from previously learned material and from activities occurring after the learning had taken place (11:125-126).

6. Perception. Perception was defined as the process by which individuals screen, select, organise, and interpret stimuli so that the stimuli have meaning. Perceptual selectivity and perceptual organisation determined what stimuli were taken in and what response was made to a given stimuli (7:64).

Individual Differences. The research reviewed indicated the importance of many individual differences in determining the effects of learning variables. One method adopted to overcome the variance of individuals was to design the training program to suite the students on an individual level. Goldstein suggested four strategies for matching the training to the individual:

1. The program could have fixed objectives which all trainees met without a fixed time scale for completion.

2. There could be different programs for different, homogeneous groups.

3. Individual differences could be eliminated by branching to remedial programs when a trainee failed to meet a criteria. The normal program would then be rejoined when the deficit was made up.

4. Instructional methods could be altered to meet the needs of the individual. This approach was known as aptitude-treatment interaction (ATI) (11:197-200). The difficulty with ATI was to match the method and the aptitude correctly.

Instructor Effectiveness

Just as individual differences in trainees caused different levels of performance, variations between instructors would be expected to contribute to variation in training outcome. Roscoe and Telfer both suggested that the instructor may be the source of the majority of variance in pilot training (26:173; 35:169).

Measurement of Teacher Effectiveness. A number of approaches to measuring the effectiveness of teachers have been taken. Trent and Cohen stated that student growth after exposure to a particular teacher was the logical criterion variable (37:1040-1041). However, they noted a methodological problem associated with defining teacher competence in these terms. Their review of 1,000 studies in the literature in 1967 revealed only 20 which used student growth as the criterion (37:1041). Instead, student ratings of teacher effectiveness were often used. In studies using student ratings as a criterion they found five factors repeated consistently:

1. Clarity of organization, interpretation and explanation;

2. Encouragement of class discussion and the presentation of diverse points of view;
3. Stimulation of students interests, motivation and thinking;
4. Manifestation of attentiveness to and interest in students;
5. Manifestation of enthusiasm (37:1044).

Ryans further concluded that the characteristics of an effective teacher were relative to the situation where measurement took place (29:370). He developed an instrument based on observed teacher behaviour and called it the Teacher Characteristics Schedule. Ryans found reliabilities between 0.70 and 0.80 for a measurement scale of predictor variables using the following teacher characteristics:

1. Warm, understanding, friendly vs. aloof, egocentric, restricted classroom behavior.
2. Responsive, businesslike, systematic vs. evading, unplanned, slipshod classroom behavior.
3. Stimulating, imaginative vs. dull, routine classroom behavior.
4. Favorable vs. unfavorable opinions of pupils.
5. Favorable vs. unfavorable opinions of democratic classroom procedures.
6. Favorable vs. unfavorable opinions of administrative and other school personnel.
7. Learning-centered ("traditional") vs. child-centered ("permissive") educational viewpoints.
8. Superior verbal understanding (comprehension) vs. poor verbal understanding.
9. Emotional stability (adjustment) vs. instability (29:388).

Rosenshine and Furst, in a review of the literature in 1973, found teacher behaviour variables to have the following correlations to student achievement:

1. Clarity. Teacher clarity yielded significant correlations (r=0.37 to 0.71) in all seven studies reviewed

where it was used but researchers failed to clearly define clarity.

2. Variability. Again this term did not have a consistent definition among researchers, but was generally a description of the approach taken by the teacher. Four studies, out of four, found significant correlations ($r=0.24$ to 0.54) with measures of flexibility or adaptability. Two studies, out of four, also found significant correlations with measures of the variety of cognitive levels of discourse.

3. Enthusiasm. Significant results were obtained in all six studies using this variable ($r=0.36$ to 0.62).

4. Task-orientated and/or businesslike. Significant results were obtained in six out of seven studies using this variable ($r=0.42$ to 0.61).

5. Criticism. Significant, negative relationships were found in six out of 17 studies ($r=-0.38$ to -0.61). No study showed a significant relationship between mild criticism and student achievement but 10 out of the same 17 studies showed higher negative correlations between harsher criticism and performance.

6. Teacher Indirectness. Measures of direct versus indirect styles were developed by Flanders (9:102). Although significant results were seldom found, positive correlations favouring the use of student ideas (indirect approach) were found in seven out of eight studies ($r=0.17$ to

0.40), and a higher indirect/direct ratio were found in 11 of 13 studies (27:156-157).

Summary. There are a number of ways to look at instructor effectiveness. The ideal way was thought to be to measure the growth in criterion behaviour in students as a result of exposure to an instructor. Although this method could be approximately achieved in pilot training, since an instructor sometimes takes a particular student through a complete phase of training, no formal means of measuring an instructor's success currently exists. Indirect measures have been used in educational studies. In educational research, student ratings of instructor effectiveness were found to be reliable on some measurement scales.

Pilot Training

Interest in improving the efficiency of pilot training, always an expensive process, has a long history. For instance, selection procedures in use today have their roots in the tests developed to reduce the wastage rates during the massive training programs undertaken in World War II (14). Research in the field may have reached a stage of incrementalism; the big steps having been already taken. Computer searches of the aviation/psychology data banks revealed little current research into pilot training, although some work is still being done in the field.

Research can be broken into two main approaches. One direction has been an attempt to develop better measures for

predicting an individual's success on a pilot training course. The other direction has been to attempt to establish dimensions along which successful students differ significantly from unsuccessful students. The aim of the first approach is most applicable to the selection process. The second approach is more applicable to training methodologists attempting to improve the success rate of students once they have been selected. As there is a close relationship between selection and the training program, some studies had application to both areas. For this review, studies purely related to selection have not been reported.

In 1966, Smode et al published a report which assessed all research data up to that point with implications for the training of pilots. Although this was a particularly wide ranging review of literature in many research fields, citing 338 studies, they found few experimental research studies incorporating any manipulation of instructional variables. Their conclusion was that it would be a fruitful area for research (31:60-65).

Anxiety. In a study originally aimed at improving selection success, Bucky measured anxiety levels in US Navy aviation candidates at different stages of their training with a self reporting test: the State-Trait Anxiety Inventory. Bucky reported a significant difference ($t=1.96$; $p<0.05$) in state anxiety between those who dropped out of the program at their own request and those who completed the

training. Those with the highest levels of state anxiety were also found to be likely to drop out earlier in the program (5:29-30). State anxiety has been shown in other studies to be related to stress and therefore to vary from situation to situation. As previously discussed, Telfer and Biggs suggested classical conditioning as a strategy instructors could use in overcoming high levels of student anxiety (35:96).

Delineating Factors. In 1976, King and Eddowes (16) reported on a study conducted at Williams AFB which looked at the similarities and differences between superior (top quarter of graduates), marginal (bottom quarter of graduates) and eliminated pilot training students. The measurements were made with structured interviews. There were 61 superior students, 58 marginal and 28 students eliminated as a result of flying deficiency. Relevant significant results from King and Eddowes study are shown in Table I.

King and Eddowes found a mildly significant positive relationship (p-value < 0.10) between the level of student performance and student assessment of the experience level and performance of the instructor. Their study did not allow inferences to be drawn which specified cause and effect but the result is interesting, given the methodology of the current study.

TABLE I

Significant Difference Dimensions

Factor	No of Students With Particular Level of Flying Training Skill		
	Superior (N=61)	Marginal (N=58)	Eliminated (N=28)
1. Entered Course Due To The Influence of Parent Or Relative In The Air Force Or Who Is A Pilot	16	11	4 +
2. Perceived Training Problems:			
a. Presolo Landing	8	14	16 ++
b. Loss of Confidence	6	12	14 ++
c. Final Turn - Approach - Flare	2	8	13 ++
d. Air Sickness	0	2	6 ++
e. Feeling of Pressure	4	2	6 +
3. Perceptions of Ineffective IP Teaching Characteristics:			
a. Poor Prebrief	12	10	0 +
Inexperienced Teacher	11	18	11 #
c. All Criticism- No Praise For Accomplishments	8	17	10 +
d. Destroys Students Self Confidence	6	12	7 #
e. Impatient	2	5	5 #

Key: # $p < 0.10$
+ $p < 0.05$
++ $p < 0.01$

Note: 1. King and Eddowes analysed their data using the chi-squared statistic but only reported frequencies, percentages, and significance levels.

2. This table contains data from tables 3,4 and 8 reported by King and Eddowes (16:8,9, and 12).

RAAF Pilot Training

Revision of RAAF pilot training has been achieved through an ongoing process of staff review, mainly within the Flying Training Schools and Headquarters Support Command. Studies of the process by external observers have been rare. In the 1970's two symposiums were held on the subject of air training. These symposiums brought together interested parties from throughout the RAAF for an exchange of ideas on all matters of flying training at undergraduate and post graduate levels. No papers on the success rate of trainee pilots were presented at either symposium.

A major study of the flying training scheme was undertaken in 1981 (38). The objectives of the review were as given below:

1. Identify the skills, knowledge and attitudes required to perform the tasks of an operational RAAF pilot (to include probative occupational analysis of the skills, knowledge and attitudes of an operational RAAF strike pilot).
2. Determine the training systems which the RAAF could adopt to train pilots from ab-initio flying training to operational captaincy in all present RAAF roles. The examination of possible training systems is to include common training for all RAAF pilots to wings standard and various degrees of stream training.
3. Determine any requirement for pilot multi-role capability or potential.
4. Evaluate the options identified in objective 2 and recommend the method which would most efficiently meet RAAF requirements. The evaluation is to include consideration of possible force expansion requirements (38:Annex A).

As can be deduced from the objectives, the study had a wide scope and placed high demands on the two man team, who produced their final report in eight months. The success rate of students on the pilot training course was used in the

review as an indication of the throughput efficiency of various options. According to the report, the RAAF had accepted a success rate of 50 percent as a planning figure for recruiting trainees. As the report also stated, this was a particularly high figure given a screening, or selection, procedure which allowed only 6% of all applicants to actually start the course (38:section 2, page 8).

While that section of the report relating to suspensions relied more on judgement than analysis, some gross measures were quoted. For example, a study of suspension reason versus phase in the course when suspension occurred was made for the 21 courses conducted between 1973-1980 (38:section 2, pages 3-5). The success rate over the period was 57.6% (implying 42.4% were suspended). Table II shows how the 42.4% suspended during the period were categorised. The report noted that categorisation of suspensions was made extremely difficult due to relationships suspected to exist between categories. For example, a student doing poorly in flying was likely to concentrate on this aspect to the detriment of ground school and might have been classed mistakenly as a ground school failure.

TABLE II

Reason For Suspension

	Air Failure	Ground Failure	Own Request	Personal Qualities	Medical
Percentage of Students Starting Courses 1973-1980:	27%	4.3%	7.2%	0.4%	3.5%

Table II showed that slightly over 30 percent of starting students failed air or ground training assessments during the period. The report concluded that selection procedures needed to be reviewed to improve the probability of success of students and that the programing should be altered to reduce peaks in student workloads (38:section 8, page 2). Neither of these conclusions is supported by quantitative evidence though they may well be based on sound judgement.

Dr. Ross Telfer, of the University of Newcastle, undertook a limited study of the instructional process within the RAAF in 1981 (36). This was truly an outsider study. To gather data he administered separate questionnaires to samples of instructors and students. His sample consisted of 21 instructors and 17 students drawn from both flying training schools. Some of the issues covered by his questionnaire were estimates of number of hours to solo; difficult units of learning and instruction; perceived additional training needs for instructors; an evaluation of

present instructional standards; and suggestions for change (36:1). Some of his results that are of interest to this study were:

1. 47% of students and 38% of instructors reported that there was no need for further training of instructors. A further 29% of students and 14% of instructors felt that teaching experience by itself would improve instructional ability (36:5).

2. 71% students and 86% instructors rated inflight remediation as effective (36:6).

Telfer's study was the forerunner to the Bongers/Rowe study. The current investigation is also a continuation of that same line of research.

Another study was undertaken in 1983 by Squadron Leader Stephen Longbottom (18). He conducted a historical study of suspensions on RAAF pilot courses. This involved collection of categorical data (e.g. phase of training in which suspension occurred) from all suspension reports available for students suspended from Number 1 to Number 122 Pilots' Course (courses conducted from 1947-1983). The data were grouped according to the changes that had occurred to training syllabuses and type of training aircraft over time. Comparisons were then made between the various schemes in terms of their efficiency in producing graduates. Longbottom found that the proportion of students suspended in the latter courses (Numbers 99-120 Course) was significantly higher than

in all previous groupings. The higher proportion of suspensions did not result in a higher number of hours (cost) to graduate each student, though, as students were suspended earlier in the course (19:14-16).

Longbottom also concluded that a more effective screening process was needed to improve the probability of a student surviving the training. He offered some empirical evidence for the adoption of a flight screening program to achieve this result. Courses 1-30 had been recruited as aircrew and were separated into pilots, navigators and so on after having been assessed over 15 hours of flying instruction. His measures showed this scheme to be more efficient than all subsequent ones (19:12-13). In fact a USAF research project, using an experimental design, suggested that the true benefit of a flight screening program was in the experience and training effect it generated. The experiment found that additional hours (20 hours versus 14 hours) resulted in an even greater success rate (33:7-8).

The final study made on the RAAF pilot training course was completed in 1987 by Rowe (28). The conclusions of that study lead directly to the approach taken in the current study. The questionnaire administered by Bongers used open-ended style questions which yielded a great wealth of qualitative data which were not conducive to statistical analysis of any depth. Some relevant information provided by Rowe's analysis included:

1. 79% students said that overload impaired their preparation for ground school or flights from a slight to moderate degree.

2. 32% students said they were required to learn material to too great a depth, mostly in meteorology, aircraft systems and aerodynamics.

3. 49% students had no difficulty with any aspect of flying instruction, but 11% of the students found standardisation among flying instructors to be a problem.

4. 63% of students had no difficulty relating to their flying instructors, while 12% said they had communication difficulties.

5. 36% students applied for pilot training to fly military aircraft. 25% of students saw their primary role as a RAAF pilot to be flying military aircraft.

6. When asked what their source of satisfaction/ dissatisfaction was, 38% of students said a sense of achievement and a further 18% said the enjoyment of flying.

7. Rowe reported that students gave significantly lower ratings ($p = 0.001$) of the effectiveness versus the importance of:

a. mass briefs,

b. preflight briefings,

c. inflight demonstrations,

d. inflight evaluations,

e. inflight remediations,

f. instructor/student relationship,and

g. the preparation and use of teaching aids.

8. One course, Number 137 Course, was surveyed at the end of 1FTS and 2FTS. Rowe found a significant reduction ($p < 0.5$) in the ratings these students gave for the effectiveness of mass briefings, inflight demonstration, inflight remediation, caring for frame of mind and use of teaching aids over the length of the course (28:62-75).

Summary

The literature on training in general, and on flying training in particular, has consistency and direction. Learning theories have been developed over many years into two main models of the human learner. One looks at the learner as a reactor to environmental stimuli and the other is concerned with internal cognitive processes. From the behavioural approach stems the concepts of conditioning and reinforcement. The cognitive approach provides strategies for instruction and learning.

Learning is a function of the learners readiness to learn, motivation, and the situation in which learning takes place. Aptitude and experiences are determinants of readiness to learn. Motivation can be thought of in a number of ways, including Locke's approach which sees motivation as a desire to reach a goal. The learning situation is the sum of instructional and practice variables.

Measurement of an instructor's effectiveness can be achieved using student perceptions so long as the scales used are correctly specified. Ideally though, instructional effectiveness is measured by observing growth in student criterion behaviour after exposure to an instructor.

Past research has identified differences between students who succeed on pilots' course and those who fail. Some of these differences have implications for the screening process used to select candidates for the course. Others point to perceived differences in treatment during the course. These later differences are the subject of this study.

III. Methodology

Chapter Overview

This chapter reviews the method used to solve the research questions posed in Chapter I. First, the population studied and the data collection methods used will be described. Second, the method developed to measure the constructs of interest to this study will be presented. Finally, the statistical procedures used to analyse the data will be outlined.

Experimental Design

The research questions posed in Chapter I required collection of measures of the level of learning and motivation, experienced by individual students on the RAAF pilots' course (1; 4). As there was no existing data on these measures, an instrument had to be developed to collect it. The aim of the study was to answer the research questions by using a correlational design which incorporated the results of the survey using an instrument specifically developed for this project, the collection of scores on pre-training aptitude tests for all students, and collection of the end of course results for as many students as possible within the time constraints imposed by the thesis process.

These three observations of the students were spaced apart in time. The aptitude tests were done at least six months before the commencement of training for most applicants. For graduates of the Defence Force Academy, the aptitude tests were taken approximately four years prior to the questionnaire. The questionnaire was completed by students in each of the five phases of the course. The final observation due to be taken at graduation from the respective schools, varied in time interval from the survey date depending on an individual's degree of completion of the course at the time of survey administration.

Population and Sample

The population of interest for the study was students who had been trained, or would be trained, on the current training aircraft types, and with the current training syllabus. This group included all students from Number 99 Pilots' Course up until the next significant change which is yet to occur to the training system. Number 99 Course started training on the, then newly acquired, CT-4 Basic Trainers in 1976 (19:7).

The training system remained relatively stable from 1976 until 1987. However, females were accepted for pilot training for the first time in 1987 and there may have been other changes to the recruiting procedures between 1976 and 1987. Therefore, courses beginning in 1987 and later, were of primary interest.

All the students at the Flying Training Schools in late March and early April 1988 were sampled. The students were on Numbers 143 to 147 Pilots' Courses, or had been recently suspended from a course. Students were not given a choice about participation although a small number of students were unavailable for taking the questionnaire. The respondents were identified solely by a four figure code assigned by the Directorate of Psychology. Table III shows the distribution of replies.

TABLE III

Reply Breakout

Category Of Students		Number In Category	
1 FTS		49	
2 FTS		56	
	subtotal		105
No 143 Pilots' Course		13	
No 144 Pilots' Course		18	
No 145 Pilots' Course		25	
No 146 Pilots' Course		22	
No 147 Pilots' Course		27	
	subtotal		105
Married students		14	
Single students		91	
	subtotal		105
Directly from high school		7	
From civilian employment		41	
From tertiary educational institutions		19	
From Academy training		20	
RAAF navigators		2	
RAAF officers of other categories		1	
From the other ranks (RAAF)		6	
Serving in the RAN		9	
	subtotal		105
Female students		2	
Suspended students		1	
Total of returned questionnaires			105

Survey Instrument

Since physical distance and time available made interview impossible and since direct observation of students in flying training was never possible, a survey instrument was developed to measure the levels of learning and motivation being experienced by each student on course at the time of administration. The instrument was based on part of Rowe's prototype survey questionnaire (28:95).[2]

Due to time constraints foreseen in developing a suitable instrument and administering it in Australia, normally ideal research procedures were reversed. The survey instrument was developed before a review of the educational and training literature was completed. Initial versions of the survey instrument were pilot tested at both Flying Training Schools in November/December 1987. Five students at 1FTS and four from 2FTS were chosen by the psychologists at the respective schools to complete the pilot questionnaire. Comments were invited on the last page of the questionnaire. These comments on difficult and not applicable questions proved to be invaluable in the development of the final version. Comments were also received from experts in survey research which helped to produce an instrument with, at least, face validity. A copy of the final survey instrument is at Appendix B.

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[2]. See items 126 - 171 in Rowe's questionnaire (28:103 - 107).

Constructs

The survey instrument was designed to measure the effect of three aspects of training thought to affect a student's performance on RAAF Pilots' Course. These factors, identified by Rowe, were learning, motivation and evaluation. Rowe's operational definitions of learning, motivation, and evaluation were used as a framework to develop the survey items (19:79).

However, the educational literature review gave new insights into the operationalisation of these constructs. As a result, items had to be grouped in ways not fully anticipated in the questionnaire design process. Consequently, the measures of interest changed from Rowe's three constructs to a measure of the quality of instruction and a measure of the level of motivation.

Quality of Instruction. The amount of learning a student experiences is assumed to be directly related to the quality of instruction received. It is measured in the survey instrument by items relating to:

1. the degree to which the instructor uses standard teaching techniques (STDTECH),

2. the degree to which instructors are perceived as warm and caring by the students (CAREINST),

3. the ease of communication between instructor and student (COMMUNIC), and

4. the level of enthusiasm shown by an instructor (ENTHUS).

Motivation. The level of student motivation is measured by items relating to:

1. processes and things thought to influence motivation (MOTIVATE),

2. the difficulty of the training goals perceived by students (HARDGOAL),

3. the clarity with which the students perceive the training goals (CLEARGOL), and

4. the perceived benefit of the feedback students are given about their progress towards the training goals (KNOWRESU).

Attempts were made to develop other scales, based on constructs found in the literature review. Although items could be grouped adequately from a conceptual point of view, the resulting scales often proved to be too unreliable to give useful insight. Examples of dimensions which were tried and rejected on this basis were:

1. extrinsic versus intrinsic motivation,

2. degree of positive reinforcement,

3. clarity of instruction, and

4. degree of professionalism shown by instructors.

Table IV shows how items were grouped into the scales actually used. The symbol "R" following an item number indicates that it was reverse scored (an answer of "strongly

agree" was given a value of 1, "strongly disagree" became a 6 and so on). A measure of reliability for each measure is also shown. Reliability is a statistical analysis of the reproducibility of a measurement variable made up of several items. The reliability quoted in this paper is known as coefficient alpha and it can range between 0.0 (for a completely unreliable measure) and +1.0 (for a completely reliable measure).

TABLE IV

Learning and Motivation Variables

Variable	Item Numbers Making Up Scale	Coefficient Alpha
STDTECH	43, 56, 57, 58, 59(R)	0.66
CAREINST	8, 9, 10	0.67
COMMUNIC	36, 37, 38, 39(R)	0.76
ENTHUS	7, 12(R)	*
KNOWRESU	15, 16, 24(R), 34(R), 46	0.65
MOTIVATE	17(R), 19(R), 29, 33, 42(R), 44, 60(R), 61	0.67
HARDGOAL	28, 32(R), 40, 54	0.61
CLEARGOL	30, 31, 35, 47, 48, 50, 55(R)	0.77

* the reliability of a two item scale has no meaning, the correlation between item 7 and item 12 was significant ($r=0.45$ and $p<0.001$)

Variable Descriptions

The literature review in Chapter 2 highlighted the importance of the conditions of learning and instructor effectiveness in determining training outcomes. Variables developed from the survey information were designed to measure aspects of these important influences. Specific descriptions of the variables are as follows:

1. STDTECH. RAAF flying instructors are taught how to teach flying at the Central Flying School (CFS), East Sale. Over many years of flying training certain standardised techniques have been found to work and these are taught at CFS. The key sequence of instruction is to demonstrate a new manoeuvre, prompt the student through a first attempt and then allow the student to perform the manoeuvre without assistance. More complex manoeuvres are broken into parts which are practised separately before combining them into a sequence. Instructors are taught to redemonstrate a manoeuvre if the student does not make a reasonable first attempt and they should encourage the student verbally to achieve the desired result. The items combined under STDTECH attempt to measure the degree to which students perceive their instructors to use these standard techniques.

2. CAREINST. The manifestation of attentiveness to and interest shown in students were scales often used in measures of teacher effectiveness in the literature (37:1044). Ryans' Teacher Characteristics Schedule used warm, understanding and friendly versus aloof and egocentric as one dimension (29:388). CAREINST is a measure of the degree instructors are perceived as being warm, open, and concerned about their students.

3. COMMUNIC. Flying instruction is extremely personal. The ease with which communication takes place between the instructor and the student is an important factor in

determining the success of the training process. COMMUNIC measures the ease of communication between instructor and student as perceived by a student.

4. ENTHUS. ENTHUS measures the degree of enthusiasm for their work that flying instructors display.

5. KNOWRESU. Knowledge of results in the learning process is the feedback to a learner of the results actually obtained compared to the planned goals. Items linked under KNOWRESU measure the degree to which students perceive they are getting this feedback from their flying instructors.

6. MOTIVATE. MOTIVATE is a composite variable made up of a number of aspects of the training which the author assessed would help determine levels of student motivation. Both content and process theories of motivation were influential in the choice of items. The items refer to the type of role model offered by the instructor, the length of the course, and the environmental conditions the students face at work and outside of work.

7. HARDGOAL. The level of difficulty the students ascribe to the course is measured by HARDGOAL.

8. CLEARGOL. Students may not always appreciate the purpose of training activities in general and flying sequences in particular. CLEARGOL links items which measure how clearly the students believe they see the aims of flying training activities.

Two variables at a higher level of aggregation were also defined. These were made up by summing the items making up variables defined in Table IV:

1. Quality of instruction (QUALINST) = STDTECH + CAREINST + COMMUNIC + ENTHUS (reliability: coefficient alpha=0.82).

2. The sum of all motivation variables(ALLMOT) = MOTIVATE + HARDGOAL + CLEARGOL + KNOWRESU (reliability: alpha=0.84).

In summary the process of finding reliable scales was accomplished mainly by the author linking items which were related conceptually to a dimension suggested by the educational literature. The scales were then checked for reliability using the RELIABILITY procedure provided by the Statistical Package for the Social Sciences, version 10 - SPSSx (32). A reliability level of coefficient alpha=0.7 was to have been the cutoff level. In practice, the rudimentary level of sophistication of the instrument forced the author to accept slightly lower scores.

One other approach was also adopte.' As a confirmation of the framework developed conceptually, a factor analysis was run on the 38 items which made up the scales. SPSSx provides a procedure, FACTOR, which can extract factors based on maximising the alpha value of a group of variables. Although factor analysis is not recommended for situations where the number of cases is less than about 10 times the

number of items (15:384), the analysis did confirm some of the scales derived conceptually. It also helped identify a new scale (COMMUNIC).

Other Variables. Some other variables were defined for analysis, as follows:

1. MEMORISE. Items 62, 63, and 64 were added to the final survey instrument in an attempt to study the way students processed information from short term (or working) memory to long term memory. Two items (items 62 and 63) refer to coding techniques, while item 64 refers to rehearsal (3:77). Although the items individually have meaning for analysis, a combined item (MEMORISE) was formed which scored students answers from zero (if a student answered no to each question) to three (if a student answered yes to each question). Therefore MEMORISE measures the number of different techniques a student uses to memorise information needed for flying training.

2. HOURS. HOURS is a classification variable which categorises students according to the number of flying hours they had in powered aircraft before starting the course. The levels and definitions used are shown in Table V.

TABLE V

Powered Aircraft Flying Hours

Classification Level	Definition
1	<= 5 hours
2	> 5 and <= 35 hours
3	> 35 and <= 70 hrs
4	> 70 and <= 150 hrs
5	> 150 and <= 300 hrs
6	> 300 hours

3. GHOURS. GHOURS classifies students according to the number of hours gliding they had prior to the pilots' course. The levels and definitions are contained in Table VI.

TABLE VI

Glider Flying Hours

Classification Level	Definition
1	<= 1 hour
2	> 1 and <= 5 hours
3	> 5 and <= 15 hrs
4	> 15 and <= 45 hrs
5	> 45 hours

Aptitude Scores

Aptitude tests are given to all applicants for pilots' course.[a] Some of the tests are given to all officer candidates (the commission battery) and others are specific

[a]. The author is indebted to the Directorate of Psychology (Air Force Office) Department of Defence, Canberra, Australia for the information presented here on aptitude testing.

for pilot applicants (pilot aptitude battery). Results are reported using a stanine score, or a score which compares an individual's result to all applicants in the previous five years. Using this method scores are placed on a normal distribution as follows:

Stanine 9	:	The "top" 4 percent
Stanine 8	:	The next 7 percent
Stanine 7	:	The next 12 percent
Stanine 6	:	The next 17 percent
Stanine 5	:	The next 20 percent
Stanine 4	:	The next 17 percent
Stanine 3	:	The next 12 percent
Stanine 2	:	The next 7 percent
Stanine 1	:	The next 4 percent

Commission Battery. The commission battery consists of the following tests:

1. Verbal Reasoning (VRB). This is a test of vocabulary and ability to comprehend logical relationships between words.

2. Reading Comprehension (RCOMP). Comprehension of written text is measured in this test.

3. General Ability (B42). In this test there are verbally orientated questions, applied arithmetic or "logical" problems, questions about relationships between pictorial figures, and questions requiring identification of the next number in a series of numbers.

Pilot Aptitude Battery. The pilot aptitude battery consists of the following tests:

1. Visualisation of Manoeuvres (VM). This test presents information pictorially. Aircraft are shown before

and after a stated manoeuvre. The candidate has to choose the correct picture to match a described manoeuvre after being given an initial position picture.

2. Instrument Comprehension (IC). Information is presented by drawings of a compass and an attitude indicator. The candidate has to choose a picture which correctly shows the attitude of an aircraft given indicated instrument readings.

3. Aviation Information (AVINF) This test samples the candidates aviation knowledge.

4. Complex Coordination Test (COORD). This test requires a candidate to centre a moving light on a screen using a control column and a set of rudder pedals.

All the stanine scores available for students who completed the survey instrument were added to the database containing the results of the survey of students. They were then available for combination with the measures on learning and motivation into a predictive model of success on pilots' course. Two variables were defined which combined multiples of the aptitude scores into a single variable:

1. APTITUDE. APTITUDE is the sum of all commission battery and flying aptitude scores.

2. FLYAPT. FLYAPT is the sum of all the flying aptitude scores.

End of Course Result

An independent measure of end result for all surveyed students was sought to check the validity of the theoretical model which assumed that aptitude, motivation and the quality of instruction could be combined to determine the final result of individual students. The form of this measure which could be obtained varied from course to course as a result of their different positions in the training stream. A normalised final mark, which combined 2FTS scores in ground school subjects and marks for flying, was used for Number 143 and Number 144 Pilots' Courses. This mark, known as TSCORE in the computer program, resulted from fitting raw scores from the previous five years results into a normal distribution with a mean of 50 and a standard deviation of 10. No final result of any kind was available for Number 145 Pilots' Course. For Number 146 Course a categorical variable (RESULT) was defined which classified students into those who achieved a distinction, credit, pass, or fail on completion of No 1 FTS. A "pass" or "fail" dummy variable (RESULT) was defined for No 147 Course. RESULT for No 147 Course classified them into those still on the course and those who had been suspended subsequent to completing the questionnaire.

Statistical Procedures

The data was analysed using the Statistical Package for the Social Sciences (SPSS), version 10, on a mainframe

computer at the USAF Institute of Technology. SPSSx provides a relatively simple programming environment for complex statistical procedures. The procedures used will be described briefly below.

Frequencies. The FREQUENCIES procedure was used firstly to check the program was reading the data correctly. At the same time, the shape of the distribution and the variability of the data was easily observed using the histogram option available with frequencies (22:33). Statistics collected with the FREQUENCIES procedure enabled checks on the normality of the variables, defined above, before their use in other analysis procedures.

Correlation. The PEARSON CORR procedure was used to generate Pearson correlation product moment correlation coefficients for all possible pairs of answers from the survey. The main purpose of producing this large matrix was to get an insight into inter-relationships between items and to get an indication of the complexity of those relationships. The use of Pearson's correlation in this circumstance was thought justified while, at the same time, noting Nie et al's caution about its use with ordinal-level measurements (21:276). The PEARSONS CORR procedure was also used to investigate relationships between the variables created for analysis and defined above.

ANOVA. Analysis of variance (or ANOVA) is a statistical procedure for the identification of relationships between

predictor variables and criterion variables. Using ANOVA techniques, the variation in criterion variables is partitioned into component parts attributable to the model predictor variables and residuals(15:273). SPSSx procedure ONEWAY produces a one-way analysis of the variance in a single continuous criterion variable for various levels of a single grouping (or categorical) variable. By comparing within group variability about the mean of the criterion to the variability between the group means for the criterion, any real differences between group answers can be highlighted (22:110). Multiple comparison techniques are necessary, once a difference has been detected, to identify the particular groups which differ by a statistically significant amount. Tukey's method of multiple comparison selects a critical distance between the means which has a probability of alpha of causing a conclusion that a difference between groups exists when in fact none does. The default value of alpha=0.05 was used.

Regression

The nature of relationships between predictor and criterion variables can be analysed using regression techniques. Kachigan summarised the objectives of regression as follows:

1. Regression can be used to determine whether a relationship exists between two variables.

2. Regression allows the description of the nature of the relationship (assuming one exists) in the form of a mathematical equation.

3. The degree of accuracy of the mathematical model developed by regression can be stated explicitly.

4. In multiple regression, the relative importance of predictor variables in their contribution to criterion variance can be determined (15:239).

Nie et al, further, suggest that multiple regression can be used to control for other confounding factors while determining the contribution of one particular variable or a subset of variables (21:321). This is an enhancement of the fourth use suggested by Kachigan. Regression was used in this research for all these purposes.

IV. Results and Discussion

Chapter Overview

This chapter presents an analysis and interpretation of the data collected in the research process. The chapter begins by discussing the results of statistical analysis of the survey instrument. Some interesting findings about the aptitude scores are discussed next. Finally, the results of analysis of relationships between the predictor variables, derived from the survey instrument, and the end of course results are reported which leads naturally to a discussion of the validity of the approach taken in the study.

Research Objectives

Before discussing the results of the survey, a reminder of the objectives of the research is appropriate. The first objective was to develop a valid instrument. Therefore, a large proportion of the analysis was devoted to the question of validity. The second objective was to test the hypothesis that individual students, with a given aptitude score, perform at a level determined by the learning, motivation and evaluation experiences they undergo during the pilots' course. These objectives were mutually dependent: the second objective could not be achieved without success in the first and the validity of the instrument was, at least, partly proven by achieving success in the second. The first

analysis task, then, was an assessment of the measurement instrument.

Primary Predictor Variables

The process of defining scales to measure levels of motivation and the quality of instruction was fully described in Chapter III. In summary the aim of the survey instrument was to reliably measure STDTECH, CAREINST, COMMUNIC, KNOWRESU, HARDGOAL, MOTIVATE, and CLEARGOL. Demographic data were also collected for their potential use in analysis.

Frequency Distribution of Primary Predictor Variables. The first step in the analysis was to derive descriptive statistics for the primary variables defined in Chapter III. Examination of the frequency distributions of these variables was necessary before deciding how they could be used in latter analysis. The main statistics of the primary variables are shown in Table VII.

TABLE VII

Statistics For Primary Variables

Variable Name	Mean	Std Dev	Min	Max	N
STDTECH	4.6	0.6	2.8	6.0	105
CAREINST	4.6	0.8	1.7	6.0	105
COMMUNIC	4.6	0.9	2.5	6.0	105
KNOWRESU	4.5	0.7	2.6	5.8	105
HARDGOAL	4.1	0.7	2.0	5.8	105
MOTIVATE	4.0	0.6	2.2	5.0	105
CLEARGOL	4.4	0.7	2.1	5.8	105
QUALINST	4.7	0.6	3.2	5.7	105
ALLMOT	4.5	0.6	2.8	5.7	90

The similarity of frequency distributions for these primary variables is apparent in Table VII. The means are all close to the seventy fifth percentile of the allowed range (1 to 6) and the standard deviation of each distribution is approximately equal. The distributions were also bell-shaped and skewed left (i.e., the tail extends further towards the lower end of the scale than the upper end). Therefore, most students were happy with the way they were taught to fly and they were satisfied with their level of motivation. However, for each measure some students have much lower scores, or levels of satisfaction. The hypothesis this research set out to prove could be restated as: those students with low scores on the scales listed in Table VII would be more likely to perform poorly in a subsequent independent measure of student performance.

Frequencies for Other Variables. Statistics for other variables, defined in Chapter III, were also obtained. Results of interest were as follows:

1. MEMORISE. All students reported using at least one of the memorising techniques listed in the questionnaire. Sixteen (15%) reported using one technique. Forty one (39%) said they used two of the techniques. Forty seven (45%) answered that they used all three techniques. One student failed to answer all the questions on memory techniques.

2. HOURS. Fifty students (48%) had 5 hours, or less, experience in powered aircraft before the course. Twenty

three (22%) had from 6 to 35 hours experience. Sixteen (15%) had 36 to 70 hours. Nine (9%) had 71 to 150 hours and the other seven students had more than 150 hours.

3. GHOURS. Most students (81 or 77%) had less than one hour's gliding experience. Six students had from 1 to 5 hours, nine had from 6 to 15 hours, six from 16 to 45, and three had more than 45 hours in gliders.

The information collected on memorising techniques was purely descriptive. With hindsight, this information would have been more valuable if students had also been asked, for example, to state the techniques they had been acquainted with as well as those techniques they used. The information on flying experience prior to the course was useful in later analyses. A relatively large percentage of students with little or no previous flying experience, about half the total, was noted at this stage.

Relationships Between The Primary Variables. The next research step was to investigate any relationships between the primary variables. Ideally, as the primary variables were designed to be measures of different concepts, they should have had little or no correlation with each other. In other words, they should have been capable of discrimination. As a corollary to this requirement, measures of similar concepts should have been more related to each other than they were to dissimilar concepts. The correlation coefficients (Pearson's r) for the primary variables are

shown in Table VIII. Table IX contains correlation coefficients between other variables of interest. The significance of correlations indicates the probability of their being no relationship between the variables in question.

TABLE VIII

Correlation Table For Primary Variables

Primary Variable	STDTECH	CAREINST	COMMUNIC	KNOWRESU	HARDGOAL	MOTIVATE
STDTECH	1.0					
CAREINST	0.14+	1.0				
COMMUNIC	0.17+	0.53*	1.0			
KNOWRESU	0.37*	0.46*	0.43*	1.0		
HARDGOAL	0.30*	-0.04	-0.13*	0.06	1.0	
MOTIVATE	0.36*	0.36*	0.26#	0.58*	0.31*	1.0
CLEARGOL	0.46*	0.32*	0.29*	0.68*	0.09+	0.56*

Key: * - p <= 0.001
- p <= 0.01
+ - p <= 0.1

TABLE IX

Correlation Results For Other Variables

Variables	Pearson's r	p - value
QUALINST with ALLMOT	0.60	< 0.001
IDA with AGE2	-0.11	0.13
FTS with AGE	0.04	0.36

The relationships shown in Table VIII indicate the source of possible difficulties in using these measurement variables with sophisticated analysis techniques. There are

significant correlations between most of the variables. The correlations between CAREINST and COMMUNIC, and between KNOWRESU and MOTIVATE are relatively high. Only HARDGOAL shows the discriminatory power desired in predictor variables. High correlations between the predictor variables reduce their potential to find significant results in regression modelling, which is an important analysis tool in this research (22:164). Table IX shows that the benefit of an increase in reliability (see Chapter III) gained by creating QUALINST and ALLMOT was almost completely offset by a loss of discrimination between the measures.

Table IX also contains the results of hypothesis tests about the relationships between Pilots' Course number (IDA) and age at the start of the course (AGE2), and the number of the flying training school (FTS) and a reclassification of age at the start of training (AGE). The results indicate that the null hypothesis (i.e., there is no relationship) cannot be rejected. These particular tests were carried out in conjunction with the next step in analysis.

<u>Variance Of The Primary Variables Across Groups</u>. One of the research questions posed in Chapter I was: What other factors are likely to influence the performance of students? Demographic information collected with the questionnaire allowed the variance in the primary variables to be separated into components using ANOVA techniques. Factors which helped explain the variance in the primary variables had potential

to explain the difference in performance of students, therefore, some effort was exhausted in searching for predictors. Table X contains significant relationships found in this way between the primary variables, listed above, and certain groupings derived from the demographic data. The analysis model used in each case consisted of a single categorical variable as a predictor and a single primary variable as a criterion. The relevant hypothesis test is that all group means are the same, versus an alternative that at least one of the means is different to the others. For example, using this analysis technique, pilots' course number can be used as a grouping variable to determine whether students making up each pilots' course gave the same responses to items forming the variable MOTIVATE, or some courses differed. The test statistic uses the F-distribution. An alpha of 0.05 was chosen as a cut-off for deciding which results were significant.

Table X contains only statistically significant results. Results for the remaining criterion variables can be found in Appendix C. The criterion variables analysed using this approach included all the primary variables listed in Table IV, plus QUALINST, ALLMOT, APTITUDE and FLYAPT.

Grouping (categorising) the data in other ways generally failed to uncover significant differences between groups (see Appendix D). Categorical variables tested, other than those shown in Table X, included prior occupation as indicated by

item 3, marriage status as indicated by item 5, number of hours in powered aircraft and gliders as classified by the variables HOURS and GHOURS defined in Tables V and VI, and finally POTENT (a classification variable which grouped students into five levels according to their score in FLYAPT). The only significant result was a model using prior occupation (PRIOROCC) to predict STDTECH.

TABLE X

Significant Differences Across Groups

Grouping Variable	Criterion Variable	F-ratio	Prob of F
COURSE # (143-147)	KNOWRESU	4.47	0.002
COURSE #	HARDGOAL	2.50	0.047
COURSE #	MOTIVATE	11.23	0.000
COURSE #	CLEARGOL	3.30	0.014
COURSE #	ALLMOT	8.03	0.000
FTS # (1 OR 2)	ENTHUS	5.92	0.017
FTS #	KNOWRESU	8.02	0.006
FTS #	HARDGOAL	8.07	0.005
FTS #	MOTIVATE	29.35	0.000
FTS #	CLEARGOL	7.66	0.007
FTS #	ALLMOT	19.67	0.000
AGE2 (1-6) *	COMMUNIC	2.62	0.029
AGE2	KNOWRESU	3.51	0.006
AGE2	MOTIVATE	2.85	0.019
AGE2	CLEARGOL	2.44	0.040
AGE2	ALLMOT	3.76	0.004
AGE2	APTITUDE	2.44	0.041
AGE (1-3) **	CAREINST	3.38	0.038
AGE	COMMUNIC	4.44	0.014
AGE	KNOWRESU	5.18	0.007
AGE	MOTIVATE	4.78	0.010
AGE	CLEARGOL	3.57	0.032
AGE	ALLMOT	6.01	0.004
AGE	QUALINST	4.68	0.011
AGE	APTITUDE	6.25	0.003

* AGE2 is derived from the answer to item 2 of the questionnaire. (An answer of 1 = 17, 2 = 18-19, 3 = 20-21, 4 = 22-23, 5 = 24-25, 6 = 26 - 27)

** AGE categorises the age of students into three categories: 1 = an age of 19 or less, 2 = 20 - 21 year's old, 3 = 22 and older.

Table X indicates that grouping the students by Course Number or age helped to explain significant amounts of the variance in some predictors. This data failed to provide evidence in support of other relationships.

Interestingly, the significant differences were found mostly in measures conceptually related to motivation and not in the quality of instruction measures. This result, by the way, was consistent with the author's experience. The quality of instruction is likely to be relatively homogeneous as instructors are trained at Central Flying School, which uses a very standardised teaching procedure, and the decision to assign instructors to a particular FTS is not specifically made on ability criteria. Motivation, on the other hand, might be expected to vary over a 15 month course with five distinct phases.

Course Differences. Another research question, posed in Chapter I, was: What changes occur over the period of the training in the level of learning, motivation and evaluation experienced by the students? The question could not be answered conclusively using this experimental design. Table X provides indirect evidence to support the theory that changes do occur over the course as the sample included one course in each phase of training at one moment in time. With FTS as the predictor, the relationships are more significant but course number and FTS are related in this study since Nos 143 to 145 Courses were at No 2 FTS and Nos 146 and 147

Courses were at No 1 FTS. As will be discussed, under the section on multiple comparisons, students at No 1 FTS scored higher than students at No 2FTS on variables which showed a significant contrast between the two schools.

Age Differences. The results for age at commencement of the course are also interesting. AGE2 was defined by the answer to survey item 2. The results in Table X show that age had a significant bearing on student answers to the survey in both quality of instruction and motivation variables. Age also explained a significant portion of the variance in their aptitude scores. From this result, age would be expected to be significant as a predictor variable for success on the course.

ANOVA was useful to find which categorical variables were significant in explaining variance in the primary variables. However, the procedure does not show which levels of the predictors are significantly different from other levels. For example, the analysis does not reveal which courses are truly different to others in levels of KNOWRESU. Multiple comparison techniques are required to make this decision.

Multiple Comparison Analysis of Significant ANOVA Results. Tukey's HSD (honestly significant difference) method of multiple comparison was chosen to compare the mean scores of each group on a variable by variable basis. A cut-off of alpha = 0.05 was used to determine which means truly

differed. The significance level of the multiple comparison test was also "protected" by only testing variables with a significant overall F-test (15:306). Table XI shows comparisons by course.

TABLE XI

Comparison Across Courses

Course #	Mean Response For:				
	KNOWRESU	HARDGOAL	MOTIVATE	CLEARGOL	ALLMOT
143	4.58	3.75	3.96	4.51	4.59
144	3.96*	3.79	3.39*	3.97*	4.03*
145	4.46	3.99	3.77+	4.25	4.40+
146	4.61	4.17	4.14	4.52	4.71
147	4.78	4.36	4.37	4.64	4.89

Notes: (*) Tukey's HSD test found that the mean for No 144 Course was significantly lower than Nos 143, 146 and 147 Courses in MOTIVATE and ALLMOT, than Nos 146 and 147 Courses in KNOWRESU, and No 147 in CLEARGOL.

(+) No 145 Course was found to be significantly lower than No 147 in MOTIVATE and ALLMOT.

The mean scores for KNOWRESU, MOTIVATE, CLEARGOL and ALLMOT in Table XI would follow a "J" shaped curve if plotted against the course number in ascending order. Students in No 147 Course, who were at the beginning of their course, have the highest scores. Scores decrease as course number decreases until reaching a minimum at No 144 Course (in phase 4 at the time of the survey). In all measures but HARDGOAL, No 143 Course scores higher than No 144 Course. The trend of these marks makes intuitive sense since students beginning

their course are relatively untested and likely to be highly motivated. Experiences on the course are likely to make them more critical of themselves and the training environment. The jump upwards in score for students who have almost completed the course (No 143 Course) could be associated with an increase in self confidence and being able to "see the light at the end of the tunnel". HARDGOAL does not show this improvement. Perhaps this is because the final flying tests were still to be done by most students in No 143 Course at the time of the survey. The differences in MOTIVATE are probably the result of differences in satisfaction with living and working conditions. Many 2FTS students commented about the living conditions at Pearce. The purpose of this discussion is to explain the intuitive sense of the results and not to state the causes of any trends. In fact, only the results marked with an "*" or "+" are significantly different. A proper longitudinal study would be required to trace the true pattern of motivation for a particular course.

TABLE XII

Comparison Across Age At The Start Of Training

Age	Mean Response For: COMMUNIC	KNOWRESU	MOTIVATE	CLEARGOL	ALLMOT	APTITUDE
17	5.5	4.2	3.8	4.2	4.4	42.0
18 - 19	5.0	4.9*	4.3*	4.7	4.9*	42.7*
20 - 21	4.5	4.4	3.8	4.3	4.4	44.5
22 - 23	4.6	4.4	3.9	4.3	4.4	47.5
24 - 25	4.0	4.8	4.2	4.7	4.8	47.3
26 - 27	4.8	4.1	3.8	4.1	4.3	46.9

Note: (*) Tukey's HSD method revealed that students who were 18 - 19 years old at the start of training were different to 20 - 21 and 26 - 27 year olds in KNOWRESU, to 20 - 21 year olds in MOTIVATE, to 20 - 21, 22 - 23 and 26 - 27 year olds in ALLMOT, and finally to 22 - 23 year olds in APTITUDE.

The differences in scores for students of various ages are shown in Table XII. However, the imbalance in the age distribution of students under training caused some difficulties for interpretation of these results. Reclassification of the age variable gave three more nearly equal groups, as shown in Table XIII.

TABLE XIII

Reclassification Of The AGE Variable

AGE2	N	AGE	N
17	2		
18 - 19	27	17 - 19	29
20 - 21	33	20 - 21	33
22 - 23	25	22 - 27	42
24 - 25	8		
26 - 27	9		

Regrouping the students also gave a clearer picture of the way a student's age at the start of training can influence student scores. As can be seen in Table XIV, the students in the 17 - 19 year grouping were higher in all scores derived from the survey instrument, yet lower in officer aptitude, than older students. At the same time, there are no significant differences in the mean scores between 20 - 21 year olds and those 22 and above for any of the variables in Table XIV. The cause of different scores on the survey instrument cannot be determined from the study.

Prior Occupation. Three students, RAAF officers from non-GD categories, rated STDTECH lower than every other group. The reason why these officers should feel differently to the other students is not apparent from the data analysis. In addition, the small number of students in this group means that only a low level of confidence could be placed in any inferences made from the result.

TABLE XIV

Comparison Across Different Levels Of AGE

Variables	Mean Response For Each Age Group:			Sig. Diffs.
	17 - 19	20 - 21	22 - 27	
	(1)	(2)	(3)	
CAREINST	4.8	4.6	4.3	1 : 3
COMMUNIC	5.0	4.5	4.5	1 : 2 & 3
KNOWRESU	4.8	4.4	4.4	1 : 2 & 3
MOTIVATE	4.2	3.8	3.9	1 : 2 & 3
CLEARGOL	4.7	4.2	4.3	1 : 2
ALLMOT	4.9	4.4	4.4	1 : 2 & 3
QUALINST	4.9	4.6	4.6	1 : 2 & 3
APTITUDE	42.7	44.5	47.3	1 : 3

Note: 1 : 2 & 3 is read: the mean response for age in column 1 (17 - 19 years old) is significantly different to the response for age in columns 2 (20 - 21 years old) and column 3 (22 and above), using Tukey's HSD method.

<u>The Predictive Properties of Course Number and Age at the Start of Pilots' Course</u>. Age was possibly acting as a confounding variable since there did not appear to be a sound conceptual reason for its affect on the primary variables. Therefore, measurement of the relative contribution of course number and age in explaining the variance in these primary measures seemed to be a logical next step. Least squares regression was the ideal tool for this analysis. For a regression analysis, course number can be thought of as a defacto "position in the course" variable, with students in Number 143 Course near completion and students in higher numbered courses equally spaced behind to Number 147 Course at the beginning of the course. Therefore, regression is a

suitable analysis tool as the predictor variables, IDA (or Course Number) and AGE2 (or age a start of the course) were at least ordinal data and the criterion (primary) variables were continuous. Linear models were compiled for the primary variables identified by ANOVA as varying significantly across groups. Table XV gives the main results, see Appendix E for further results.

TABLE XV

Relative Contributions of IDA and AGE2

Dep Variable	IDA			AGE2		
	Beta	F	Sig F	Beta	F	Sig F
ALLMOT	0.35	13.2	0.001	- 0.23	5.6	0.021
COMMUNIC	- 0.16	2.4	0.128	- 0.21	4.2	0.043
KNOWRESU	0.20	4.0	0.047	- 0.25	6.1	0.016
HARDGOAL	0.25	5.7	0.019	- 0.08	0.5	0.468
MOTIVATE	0.37	15.0	0.000	- 0.16	2.6	0.108
CLEARGOL	0.19	3.3	0.071	- 0.19	3.4	0.067

Table XV reveals the relative size of the contributions of course number and age in predicting a particular students scores for the survey primary variables listed. For example, course number and age are equal predictors of CLEARGOL but they operate in opposite directions (the higher the course number the higher the score on CLEARGOL, but the higher the age the lower the score on CLEARGOL).

Summary. The analysis up to this point has simply explored the potential of the measurement instrument to uncover significant information. The frequency distributions

of the primary variables were found to be close to normal. Relationships between the primary variables themselves were identified and comments provided. The student population was then broken into understandable categories in order to explore how different groups responded to the survey. Age and course number were two groupings which were examined in detail. In relation to the research objectives, the measurement instrument had proved to be producing valid discrimination amongst the students, at this stage. At least partial answers had been provided to two of the research questions posed in Chapter I. The next step was to examine the aptitude variable because it will later be used to achieve the second research objective, which was to build a prediction model of student performance.

Aptitude Results

Distribution of Aptitude Results. Both APTITUDE and FLYAPT were variables defined for this research. These variables do have a restricted range because applicants whose aptitude tests scores were too low to enter into training have already been eliminated. Neither APTITUDE nor FLYAPT can be directly translated into the scores used by the RAAF in screening applicants for pilot training. However, the variables, as defined, do order students according to their aptitude results. The distributions for the two variables were found to be bell shaped about their means. Statistics

of interest were as follows:

1. APTITUDE. The APTITUDE variable ranged from 33 - 60, with a mean of 45 and a standard deviation of 5.5.

2. FLYAPT. FLYAPT ranged from 18 - 36, with a mean of 26.5 and a standard deviation of 4.

Relationships Between Aptitude And Other Variables. Age had already been shown to be significantly related to APTITUDE using ANOVA techniques. However, the relationships between the primary variables, other continuous variables, and FLYAPT were most relevent to the study. Therefore, a stepwise regression was attempted using GLIDER, ACFT, STDTECH, CAREINST, COMMUNIC, KNOWRESU, ENTHUS, HARDGOAL, MOTIVATE, and CLEARGOL as predictors of FLYAPT, with a significance cut-off of 0.05. In effect this technique was working backwards in time. That is, given a student's scores on the survey predictors, and a certain amount of powered flight or gliding experience, what aptitude score could be expected for this student?

The resulting equation (see Appendix F) contained just two variables, GLIDER and ACFT (number of hours in gliders and aircraft, respectively, prior to starting training), but was significant (F=4.81, prob of F=0.010). The beta weights, or standardised regression coefficients, of GLIDER and ACFT were 0.22 and 0.20 respectively, indicating each variable contributed approximately equally to the prediction of FLYAPT. The value of R-squared (0.09) indicated that the

equation accounted for only about nine percent of the variation in FLYAPT.

This regression result showed that the amount of previous flying experience a student had accumulated was related to the rank order determined by flying aptitude test results. Therefore, the tests are measuring familiarity with the piloting environment. The stepwise regression also indicated that the aptitude test scores of students did not have any significant relationship to their scores on the primary variables. Since aptitude would seem to be related to the level of difficulty a student faces on the course, having no relationship between HARDGOAL, for instance, and FLYAPT castes doubt on the validity of either the survey instrument or the aptitude tests.

A research question which flows naturally from this paradox is: Does the aptitude test discriminate well among the students who have little or no previous flying experience? This question is made more critical by the observation that approximately half of the students in this sample had no previous flying experience. Unfortunately, the data were not available to answer the question conclusively within this thesis project.

At this stage, then, the survey instrument was once again under question as to its validity. Although students had been shown to differ in the way they answered questions

in the survey, the real question was whether these different answers were connected with varied performances.

Relationship Between Predictors And Performance

Any relationships between the primary variables, and aptitude, and the performance of individual students were central to this project. The main hypothesis under test was that a student's performance could be predicted, given knowledge of the student's aptitude test scores, and the measures of learning and motivation developed from the survey. As the form of the performance measure obtained during the study varied from course to course, both regression and ANOVA techniques were needed to test the models. For Nos 143 and 144 Pilots' Courses, regression was a suitable tool because the criterion variable (TSCORE) was a continuous variable. For Nos 146 and 147 Courses, the final outcome (RESULT) was a categorical variable so an ANOVA analysis was needed, using RESULT as the predictor and the primary variables as a criterion.

Initially, relationships between the primary variables and the performance measure were tested in isolation. Each Course was analysed separately because the time between taking the survey and reaching a final outcome differed by course. Unfortunately, there were no significant relationships (at the 0.1 level) between the survey variables (STDTECH, CAREINST, ENTHUS, COMMUNIC, CLEARGOL, HARDGOAL,

KNOWRESU, and MOTIVATE) and the final outcome (TSCORE and RESULT) when analysed on a course by course basis (see Appendix G). At this point, the chance of being able to accept the main research hypothesis was reduced to almost zero.

However, regression models to predict TSCORE, along the lines of the original objectives, were fitted to the data for No 144 Course. One model consisted of the survey variables plus flying aptitude (FLYAPT), age at the start of the course (AGE2), number of hours in powered aircraft and gliders (ACFT and GLIDER), and the occupation before the course (PRIOROCC). Although the model was not significant (F=1.024, p=0.5), a number of coefficients tested out as significant at the 0.1 level. Table XVI shows the variables used in the model, their beta coefficients and the significance of those coefficients.

TABLE XVI

Regression Model For No 144 Course (N = 18)
Dependent Variable = TSCORE

Variable	Beta	SE Beta	F	Sig F
PRIOROCC	0.559	0.4	2.02	0.23
CLEARGOL	0.631	0.5	1.34	0.31
HARDGOAL	-1.248	0.6	5.09	0.09
CAREINST	0.883	0.8	1.32	0.32
AGE2	-0.883	0.6	2.47	0.19
GLIDER	0.022	0.4	0.00	0.96
COMMUNIC	-0.647	0.7	0.84	0.41
ACFT	1.406	0.6	4.74	0.10
FLYAPT	-0.253	0.7	0.14	0.73
ENTHUS	1.301	0.6	4.32	0.11
MOTIVATE	-0.263	0.8	0.10	0.76
STDTECH	2.013	0.9	4.96	0.09
KNOWRESU	-2.099	0.9	5.38	0.08

Despite the significance of each predictor in this equation being dependent on the presence of all the remaining variables [due to multicollinearity (22:164-165)], the relative importance of the variables is again indicated by their beta weights. Survey variables (KNOWRESU, HARDGOAL and STDTECH) were the most significant predictors in this model, even more significant than the number of hours in powered aircraft and gliders prior to the course. Another model, with a reduced number of predictors is shown in Appendix H. Both models fit negative coefficients to KNOWRESU and HARDGOAL. Although a negative coefficient would be expected for HARDGOAL, the result for KNOWRESU is surprising. KNOWRESU was derived from questions to do with the quality of feedback students received from their instructors. A negative coefficient indicates that students who rated the feedback highly, performed worse than those who rated feedback lower. This unexpected result could indicate indirectly that individual differences in need achievement and personality type are related to performance on pilots' course since those factors are known to impinge on the reaction of an individual to feedback (7:113; 3:177).

A regression model was not appropriate for Nos 146 and 147 Courses. However, the relationship of student performance to previous flying experience and age at the start of training was of interest following previous analyses. To analyse these relationships, the categorical

variable RESULT was used as an independent variable, to predict ACFT, GLIDER, FLYAPT, and AGE2 for No 146 and 147 Courses (see Appendix H). At the 0.1 significance level only AGE2 for No 146 Course showed a significant result. A model with RESULT as a predictor and AGE2 as criterion had an $F = 2.48$ with $p = 0.094$. When added to the previous findings about age at the start of course, this result gave more weight to the hypothesis that age explains a significant amount of the variance in student performance in RAAF pilot training.

Validity Of The Approach

The lack of a significant relationship between the independent measure of performance and the primary measurement variables was very disappointing. It seems quite logical to question the validity of the model and the instrument used. However, to place the result in a proper context, the failure to show significant relationships between the survey measures and the final outcome means that the validity of the survey measures was not proven but does not infer that they were proven invalid.

The search for an explanation of the poor result uncovered many problems. Firstly, the numbers of students worked with in the final analysis was small, a natural result of studying pilot training in the RAAF. The reliability of the instrument was poor. There were doubts about the

independence of the primary measurement variables. Lastly, the performance measure eventually obtained for most students did not capture the right performance. In particular, marks for ground school and flying were combined into one measure. The performance measures were also a single measure of all the work at one school, and not the work done after the questionnaire. Therefore, No 143 Pilot's Course was surveyed as they completed their course, yet the performance measure obtained for them was a single measure of the previous nine months work.

Despite these technical problems, the survey instrument did provide hints of valid measurement. At this stage, the investigation was halted.

Summary

This chapter has described the data analysis associated with this thesis. The theoretical model underlining the analysis was that students, with a given aptitude for flying training, would experience different levels of learning and motivation on the pilot training course which would influence their performance on the course.

The chapter started by outlining the investigation of the survey instrument's potential for measuring the level of motivation and the quality of instruction experienced by each student. The survey instrument obtained results for these variables which were consistent with the author's experience in RAAF flying training schools. The longitudinal cross

section of the student population, provided by the experimental design, appeared to indicate that some primary variables (KNOWRESU, MOTIVATE, and CLEARGOL) reached a minimum level in phase 4 of training. Age was shown to influence student scores on the primary variables. Students, who were 19 years old or less, when they commenced training scored higher on most primary scales than older students.

The aptitude measures were investigated next. FLYAPT appeared to favour students with previous flying experience. A student's age at the start of pilot training was also related to his or her score on APTITUDE. It was concluded that a student's age and the amount of previous flying experience the student had accumulated before starting training, should be significantly related to the student's performance.

Finally, the results of tests of relationships between predictors, developed during the research, and the student's performance were reported. There was no evidence of any relationships between the primary variables and student performance. The model which stated that a student's performance could be predicted from scores in the primary variables and aptitude was not proven. Some survey variables (KNOWRESU, HARDGOAL, and STDTECH) did show relative strength compared to other possible predictors in this model.

External validity of the instrument and model was not proven. However, the result of the validity test was

inconclusive. The performance criterion used in this research was not necessarily appropriate but it was the best available measure in the circumstances of this particular investigation. A measure of performance which was more closely related in time to the survey could well uncover stronger relationships.

V. CONCLUSIONS AND RECOMMENDATIONS

This thesis should be viewed as a continuation of the line of research begun when Mr Stan Bongers, Director of Psychology - Air Force, administered exploratory surveys to RAAF pilot trainees in mid-1985. The aim of those surveys was to gain information to help solve an ongoing air training problem of how best to improve the success rate of trainees without sacrificing the quality of the graduates?

Wing Commander Graham Rowe analysed the data gathered by Mr Bongers and recommended a more focused study of the learning, motivation and evaluation experiences of individual students. This research began by using Rowe's conclusions as a framework for the construction of a measurement instrument. Over the course of the thesis, slight changes were made in Rowe's conceptual model, nevertheless, the underlying aim remained the same: to improve the chances of success of each trainee.

An answer to the training issue has not been found. However, the research effort has clarified the part played by a number of important factors involved in the RAAF flying training system. More research will be necessary before specific recommendations for management actions can be proposed.

Conclusions

As a result of the literature review and the analysis of quantitative data, some conclusions are possible. In particular, the literature offered the following:

1. Models of learning, including conditioning and cognitive theories, are useful for guiding instructors in flying training.

2. The degree of learning which occurs in an individual is thought to be a function of that individual's readiness to learn (aptitude), motivation, and the conditions under which the learning occurs.

3. A useful way to think of motivation in pilot training is in terms of goal theory. Both students and the schools have goals. Are the goals compatible? Does the student clearly see the training goals for each flying sequence? Does the student receive unambiguous feedback on progress towards the training goals? How difficult are the training goals for a particular student?

4. Student learning, as a result of training, can only be directly measured by observation of student behaviour before and after exposure to the particular sequence of training. The normal assessment methods used in pilot training attempt to do this now.

5. In past studies of pilot training, successful students have been found to differ in psychological and

biographical ways from those who are unsuccessful. The current study lends some support to these past studies.

6. Past studies of the RAAF Pilot Training Scheme have suggested that a more effective screening of applicants was necessary to improve the success rate. An empirical study of flight screening, conducted by the USAF, indicated that flight screening did improve the success rate of those who passed the screening process. The RAAF also has evidence of the action of flight screening through the screening effect 1FTS already provides for 2FTS.

Analysis of data provided from the survey of the students at both FTSs in March and April 1988, scores in aptitude tests taken during selection for flying training, and end of course results at 1FTS and 2FTS allowed the researcher to reach the following conclusions:

1. Students do have a variety of experiences with their instructors while under training. These experiences give rise to a range of perceptions among students about instructional techniques, the degree of concern for them shown by their instructors, the ease of communication between themselves and their instructors, and the level of enthusiasm the instructors demonstrate.

2. Students differ in the way they perceive the difficulty of the course, the clarity with which they see the goals of training, and the benefits of the feedback they receive regarding their progress towards the training goals.

They also differ on their opinions about other issues which may have some affect on their general level of motivation.

3. This study demonstrated clear differences, in the levels of variables conceptually linked to motivation, between courses at various stages of training.

4. Students who commenced training at the age of 19 years, or less, were different in many dimensions to older students.

5. A student's aptitude test scores are related to the student's age at the start of flying training and the student's previous flying experience.

6. The quality of instruction appears to be consistent across the two flying training schools.

Recommendations

Unfortunately, the researcher could not effectively compare student attitudes with quality of instruction. Nor were measures of levels of motivation reliably associated with the measure of student performance obtained for the project. Therefore, the researcher is unable to make recommendations on particular flying training management issues. However, the following recommendations are made for future research:

1. A valid measure of student performance should be compiled for students who participated in this study, to test the hypothesis that there is no relationship between measures

of quality of instruction, motivation, and aptitude for an individual and the individual's performance. A separate performance measure for flying and ground school should be developed. The performance measures should be normalised, continuous variables built from flying and ground school marks for the phase of the course a particular student was in when he or she answered the questionnaire.

2. A revised instrument should be developed if no relationships are found after Recommendation 1. The current instrument could serve as a basis after deletion of items which did not prove useful. New items should be added to improve the reliability of the scales defined in Chapter III.

3. Another question which should be answered in a future research effort is whether the current aptitude tests can validly discriminate among applicants with little or no flying experience.

4. A longitudinal study, following students throughout a complete flying training course, should be conducted. Ideally, multiple courses should be used, or randomised observations should be made, to allow for general inferences. An observation of the students should be taken in each phase of training and their performance in each phase should be compiled as suggested in Recommendation 1. The longitudinal study would be more likely to find relationships as observations of suspended students would be automatically included. In contrast, this study included only the

successful students in courses who had reached the later phases.

Appendix A: Success Rates For Nos 137 to 142 Courses

COURSE NUMBER	NUMBER STARTED	NUMBER FINISHED	PERCENTAGE SUCCESSFUL
137	33	21	63.6
138	34	16	47.1
139	34	17	50.0
140	16	7	43.75
141	31	13	41.9
142	33	18	54.55

Total Started = 181

Total Finished = 92

Percentage Successful = 51%

Note 1. The figures used in this table were provided by the Command Air Training Officer, Headquarters Support Command, Wg Cdr B. E. Briggs by telephone 20 Jan 88.

Appendix B: Pilot Training Questionnaire

PART 1

DEMOGRAPHIC INFORMATION

Please circle the correct answer to the following statements.

1. My age when I first applied for pilot training with the RAAF was:

1. 17	5. 24-25
2. 18-19	6. 26-27
3. 20-21	
4. 22-23	

2. My age when I began this pilot's course was:

1. 17	5. 24-25
2. 18-19	6. 26-27
3. 20-21	
4. 22-23	

3. My occupation just prior to commencing the pilot's course was:
   1. High school student.
   2. In civilian employment.
   3. Tertiary student.
   4. Academy officer cadet.
   5. RAAF navigator.
   6. RAAF airman or airwoman (mustering?...................)
   7. RAAF officer (category? ....).
   8. Other? ....

If you circled 6, 7, or 8 please fill in the additional information in the space provided.

4. My sex is: 1. female 2. male.

5. My marital status is:
   1. Single.
   2. Married.
   3. Divorced.
   4. Widowed.
   5. Separated.

6. The highest phase of the course I have successfully completed is:
   1. I have not finished the GFPT and the IHT yet. **
   2. Phase 1 (completed GFPT and IHT).
   3. Phase 2 (completed BHT).
   4. Phase 3.
   5. Phase 4.
   6. Phase 5.

** General Flying Progress Test and Instrument Handling Test

PART 2

Use the scale below for your responses to the statements following. Please circle the number corresponding to the extent with which you **DISAGREE / AGREE** with each of the statements.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

The first series of statements relate to **YOUR** experiences with instructors **THROUGHOUT** your entire pilot's course to date.

7. My flying instructors have obviously enjoyed flying. 1 2 3 4 5 6

8. My instructors have been willing to listen to my views on how to fly. 1 2 3 4 5 6

9. My relationships with instructors have been friendly. 1 2 3 4 5 6

10. My instructors have taken a personal interest in my welfare. 1 2 3 4 5 6

11. I have often been anxious before my instructional flights. 1 2 3 4 5 6

12. My instructors have **NOT** been enthusiastic teachers. 1 2 3 4 5 6

13. The more demanding my instructors are the better my level of performance is. 1 2 3 4 5 6

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

14. All my instructors have expected me to perform my flying tasks in a standardised way. 1 2 3 4 5 6

15. After each flight, my instructors have clearly stated how I performed. 1 2 3 4 5 6

16. During flight, my instructors have usually praised me for doing a task well. 1 2 3 4 5 6

17. My instructors have abused me verbally during flight for making a mistake. 1 2 3 4 5 6

18. During the post-flight debriefing my instructors emphasise areas where I have performed poorly. 1 2 3 4 5 6

19. During dual sorties, my instructors have demonstrated low standards of flying skills. 1 2 3 4 5 6

20. When on the ground, my instructors have set an example of officer behaviour I could proudly model. 1 2 3 4 5 6

21. I have been physically struck by my instructor for making mistakes in the air. 1 2 3 4 5 6

22. I perform best with instructors who let me set my own standards. 1 2 3 4 5 6

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

The following statements are about your **LEARNING ENVIRONMENT** and relate to **YOUR EXPERIENCES** in the course **UP UNTIL NOW**.

23. Feedback provided by ground school instructors has been useful. 1 2 3 4 5 6

24. I have <u>NOT</u> had useful feedback on my performance in flying tests. 1 2 3 4 5 6

25. Students should <u>NOT</u> be told their marks for each flight. 1 2 3 4 5 6

26. Ground school exams have been programmed without consideration of the interference they create with preparation for flights. 1 2 3 4 5 6

27. No matter what programming effort was made, ground school exams would always interfere with preparation for flights. 1 2 3 4 5 6

28. The workload on this pilot's course is high. 1 2 3 4 5 6

29. Air and ground tests give me the incentive to try harder. 1 2 3 4 5 6

30. I have been taught the best ways to study for flying training during pilot's course. 1 2 3 4 5 6

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

31. I have been taught strategies for setting priorities when tasks arise simultaneously in the air. 1 2 3 4 5 6

32. I rate the workload for this pilot's course as moderate. 1 2 3 4 5 6

33. My desire to fly well has increased as I have progressed through the course. 1 2 3 4 5 6

34. Continued criticism from instructors has reduced my enthusiasm for flying training as I have progressed through the course. 1 2 3 4 5 6

35. I have been well briefed on the objectives of all tasks during flying training. 1 2 3 4 5 6

PART 3

The next series of statements relate to <u>YOUR CURRENT PHASE</u> of training. **Think of your most recent experiences.**

36. My present instructor is easy to talk to about flying matters. 1 2 3 4 5 6

37. My present instructor is easy to talk to about non-flying matters. 1 2 3 4 5 6

38. My instructor's reaction is an obvious indication that I am doing something correctly. 1 2 3 4 5 6

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

39. During instructional sorties with my current instructor I find it difficult to relax. 1 2 3 4 5 6

40. The combined demands of ground school and flight preparation caused me to feel overloaded with work three times, or more, last week. 1 2 3 4 5 6

41. My performance on a flight depends on my level of motivation. 1 2 3 4 5 6

42. I find my current instructor's behaviour is childish at times. 1 2 3 4 5 6

43. Compliments from my instructor after a well executed manoeuvre spur me on to greater effort. 1 2 3 4 5 6

44. The threat of being suspended from the course motivates me to greater effort. 1 2 3 4 5 6

45. My instructor often ignores my mistakes. 1 2 3 4 5 6

46. The criticism I get from my instructor is constructive. 1 2 3 4 5 6

47. I am always told the purpose of the flying tests I do. 1 2 3 4 5 6

48. I know what I have to achieve in the air on each sortie I do. 1 2 3 4 5 6

49. Before each ground school test I know what material will be examined. 1 2 3 4 5 6

50. I know what standard I have to meet for each airborne sequence. 1 2 3 4 5 6

51. Have you done a navigation sortie?
    1. Yes. Go to statement #52 next.
    2. No. Go to statement #54 next.

52. I am prepared for my next sortie of each type (eg. General Flying, Instrument Flying or Navigation). 1 2 3 4 5 6

53. Due to the rush to plan before flight, I am never mentally prepared for navigation sorties. 1 2 3 4 5 6

54. I have to use every weekend to catch up on work in which I have fallen behind. 1 2 3 4 5 6

55. The mass briefs I have received are poor introductions to the flying sorties which follow. 1 2 3 4 5 6

56. My instructor makes difficult airborne tasks easier by letting me learn them bit by bit. 1 2 3 4 5 6

57. The first time I perform a new flight sequence my instructor helps me do it correctly by prompting me at the right moment. 1 2 3 4 5 6

58. If I make a mess of a new sequence, my instructor immediately demonstrates it again. 1 2 3 4 5 6

59. My instructor <u>never</u> gives me enough time to practice a new sequence. 1 2 3 4 5 6

60. My performance on this course is being hampered by the conditions I live in.	1 2 3 4 5 6
61. Working conditions at this flying school are adequate to allow me to reach my full potential as a pilot.	1 2 3 4 5 6

The next three questions relate to how you prepare for flights. Answer: 1 = yes and 2 = no.

	YES	NO
62. To memorise important information I use mnemonics or codes (eg, HHELMPTL for the first letters of key words in the pre-manoeuvre checks).	1	2
63. To memorise important information, I use mental images of real objects (eg, memorising an instrument approach by picturing the path over the ground).	1	2
64. To memorise important information I use rehearsal or repetition of activities (eg, going over the next day's flight repeatedly in my mind)	1	2

PART 4

Finally, please complete the following statements:

65. Have you been suspended from training?
    1. No.
    2. Yes, I was suspended at ....

66. Prior to commencing flying training I had .... *hours* in gliders.

67. Prior to commencing flying training I had .... hours in powered aircraft.

COMMENTS

Your comments on this survey would be most welcome and may be used to improve the survey for future use. Have you any comments you wish to make?

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*** * * * <u>COMPUTER DATA COLLECTION FORM</u> * * * ***

On the data collection form, provided with this questionnaire, check you have filled in the **DATE** box and have put the last four numbers of your service number in the **IDENTIFICATION NUMBER**. Please **TRANSFER** all your answers for **PARTS 1, 2 and 3** to the form by shading the circle containing the appropriate number.

Thankyou for you participation, please hand both this questionnaire and the computer data collection form to the survey administrator.

* * * * * * * * * *

Appendix C: Differences In Primary Predictors Due To Grouping By Age, Course Number And FTS

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable STDTECH
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.9223	2	.4611	1.2906	.2796
WITHIN GROUPS	36.4453	102	.3573		
TOTAL	37.3676	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable CAREINST
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	4.4847	2	2.2424	3.3752	.0381
WITHIN GROUPS	67.7650	102	.6644		
TOTAL	72.2497	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable COMMUNIC
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	7.0669	2	3.5334	4.4442	.0141
WITHIN GROUPS	81.0967	102	.7951		
TOTAL	88.1636	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable KNOWRESU
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	4.7724	2	2.3862	5.1846	.0072
WITHIN GROUPS	46.9449	102	.4602		
TOTAL	51.7173	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable ENTHUS
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1.8864	2	.9432	1.8713	.1592
WITHIN GROUPS	51.4136	102	.5041		
TOTAL	53.3000	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable HARDGOAL
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.8972	2	.4486	.7750	.4634
WITHIN GROUPS	59.0433	102	.5789		
TOTAL	59.9405	104			

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Variable QUALINST
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2.2681	2	1.1340	4.6811	.0113
WITHIN GROUPS	24.7099	102	.2423		
TOTAL	26.9780	104			

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Variable MOTIVATE
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3.2870	2	1.6435	4.7789	.0104
WITHIN GROUPS	35.0789	102	.3439		
TOTAL	38.3659	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable CLEARGOL
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3.3019	2	1.6509	3.5686	.0318
WITHIN GROUPS	47.1872	102	.4626		
TOTAL	50.4891	104			

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Variable ALLMOT
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3.5793	2	1.7897	6.0131	.0036
WITHIN GROUPS	25.8934	87	.2976		
TOTAL	29.4727	89			

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Variable FLYAPT
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	21.3491	2	10.6746	.7945	.4547
WITHIN GROUPS	1330.1117	99	13.4355		
TOTAL	1351.4608	101			

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Variable APTITUDE
By Variable AGE

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	336.6944	2	168.3472	6.2481	.0029
WITHIN GROUPS	2424.9185	90	26.9435		
TOTAL	2761.6129	92			

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Variable STDTECH
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.2083	1	.2083	.5775	.4490
WITHIN GROUPS	37.1593	103	.3608		
TOTAL	37.3676	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable CAREINST
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.1760	1	.1760	.2515	.6171
WITHIN GROUPS	72.0738	103	.6997		
TOTAL	72.2497	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable COMMUNIC
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1.8513	1	1.8513	2.2092	.1402
WITHIN GROUPS	86.3124	103	.8380		
TOTAL	88.1636	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable KNOWRESU
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3.7352	1	3.7352	8.0182	.0056
WITHIN GROUPS	47.9820	103	.4658		
TOTAL	51.7173	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable ENTHUS
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2.8963	1	2.8963	5.9186	.0167
WITHIN GROUPS	50.4037	103	.4894		
TOTAL	53.3000	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable HARDGOAL
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	4.3537	1	4.3537	8.0673	.0054
WITHIN GROUPS	55.5867	103	.5397		
TOTAL	59.9405	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable MOTIVATE
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	8.5080	1	8.5080	29.3496	.0000
WITHIN GROUPS	29.8580	103	.2899		
TOTAL	38.3659	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable CLEARGOL
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3.4940	1	3.4940	7.6578	.0067
WITHIN GROUPS	46.9951	103	.4563		
TOTAL	50.4891	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable ALLMOT
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	5.3850	1	5.3850	19.6729	.0000
WITHIN GROUPS	24.0878	88	.2737		
TOTAL	29.4727	89			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable QUALINST
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.0016	1	.0016	.0062	.9372
WITHIN GROUPS	26.9764	103	.2619		
TOTAL	26.9780	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable FLYAPT
By Variable FTS

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2.2662	1	2.2662	.1680	.6828
WITHIN GROUPS	1349.1946	100	13.4919		
TOTAL	1351.4608	101			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable STDTECH
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.9908	5	.1982	.5347	.7495
WITHIN GROUPS	36.3196	98	.3706		
TOTAL	37.3104	103			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable CAREINST
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	4.1357	5	.8271	1.2839	.2770
WITHIN GROUPS	63.1354	98	.6442		
TOTAL	67.2711	103			

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Variable COMMUNIC
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	10.0865	5	2.0173	2.6224	.0286
WITHIN GROUPS	75.3889	98	.7693		
TOTAL	85.4754	103			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable KNOWRESU
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	7.5098	5	1.5020	3.5103	.0058
WITHIN GROUPS	41.9315	98	.4279		
TOTAL	49.4413	103			

------------ O N E W A Y ------------

Variable ENTHUS
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2.3867	5	.4773	.9278	.4664
WITHIN GROUPS	50.4186	98	.5145		
TOTAL	52.8053	103			

------------ O N E W A Y ------------

Variable HARDGOAL
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2.5752	5	.5150	.8813	.4967
WITHIN GROUPS	57.2686	98	.5844		
TOTAL	59.8437	103			

------------ O N E W A Y ------------

Variable MOTIVATE
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	4.6520	5	.9304	2.8468	.0192
WITHIN GROUPS	32.0285	98	.3268		
TOTAL	36.6804	103			

------------ O N E W A Y ------------

Variable CLEARGOL
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	5.1537	5	1.0307	2.4369	.0398
WITHIN GROUPS	41.4512	98	.4230		
TOTAL	46.6048	103			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable ALLMOT
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	5.0498	5	1.0100	3.7588	.0041
WITHIN GROUPS	22.3014	83	.2687		
TOTAL	27.3512	88			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable QUALINST
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2.1406	5	.4281	1.7654	.1271
WITHIN GROUPS	23.7647	93	.2425		
TOTAL	25.9053	103			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - - -

Variable FLYAPT
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	26.7290	5	5.3458	.3840	.8587
WITHIN GROUPS	1322.5185	95	13.9212		
TOTAL	1349.2475	100			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable APTITUDE
By Variable AGE2

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	339.5453	5	67.9091	2.4393	.0406
WITHIN GROUPS	2422.0676	87	27.8399		
TOTAL	2761.6129	92			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable STDTECH
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	2.0462	4	.5116	1.4483	.2237
WITHIN GROUPS	35.3214	100	.3532		
TOTAL	37.3676	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable CAREINST
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	4.0523	4	1.0131	1.4855	.2123
WITHIN GROUPS	68.1975	100	.6820		
TOTAL	72.2497	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable COMMUNIC
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3.4579	4	.8645	1.0206	.4005
WITHIN GROUPS	84.7057	100	.8471		
TOTAL	88.1636	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable KNOWRESU
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	7.8498	4	1.9625	4.4736	.0023
WITHIN GROUPS	43.8674	100	.4387		
TOTAL	51.7173	104			

----------- O N E W A Y -----------

Variable ENTHUS
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	3.4503	4	.8626	1.7304	.1492
WITHIN GROUPS	49.8497	100	.4985		
TOTAL	53.3000	104			

----------- O N E W A Y -----------

Variable HARDGOAL
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	5.4467	4	1.3617	2.4987	.0473
WITHIN GROUPS	54.4938	100	.5449		
TOTAL	59.9405	104			

----------- O N E W A Y -----------

Variable MOTIVATE
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	11.8929	4	2.9732	11.2311	.0000
WITHIN GROUPS	26.4730	100	.2647		
TOTAL	38.3659	104			

----------- O N E W A Y -----------

Variable CLEARGOL
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	5.8906	4	1.4726	3.3020	.0138
WITHIN GROUPS	44.5985	100	.4460		
TOTAL	50.4891	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable ALLMOT
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	8.0829	4	2.0207	8.0301	.0000
WITHIN GROUPS	21.3898	85	.2516		
TOTAL	29.4727	89			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable QUALINST
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.5655	4	.1414	.5353	.7101
WITHIN GROUPS	26.4125	100	.2641		
TOTAL	26.9780	104			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable FLYAPT
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	29.4592	4	7.3648	.5404	.7064
WITHIN GROUPS	1322.0016	97	13.6289		
TOTAL	1351.4608	101			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable APTITUDE
By Variable IDA

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	103.8749	4	25.9687	.8598	.4914
WITHIN GROUPS	2657.7380	88	30.2016		
TOTAL	2761.6129	92			

Appendix D: Analysis Of Primary Variables And Their Relationships To Various Grouping Variables

* * * A N A L Y S I S   O F   V A R I A N C E * * *

CLEARGOL

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	10.433	21	0.497	0.998	0.476
POTENT	3.937	4	0.984	1.977	0.106
HOURS	0.510	5	0.102	0.205	0.960
GHOURS	2.779	4	0.695	1.395	0.243
MSTAT	0.030	1	0.030	0.060	0.807
PRIOROCC	3.034	7	0.433	0.870	0.534
EXPLAINED	10.433	21	0.497	0.998	0.476
RESIDUAL	39.838	80	0.498		
TOTAL	50.271	101	0.498		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

HARDGOAL

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	15.161	21	0.722	1.410	0.139
POTENT	1.557	4	0.389	0.760	0.554
HOURS	4.453	5	0.891	1.740	0.135
GHOURS	4.046	4	1.012	1.976	0.106
MSTAT	1.105	1	1.105	2.160	0.146
PRIOROCC	5.231	7	0.747	1.460	0.194
EXPLAINED	15.161	21	0.722	1.410	0.139
RESIDUAL	40.952	80	0.512		
TOTAL	56.113	101	0.556		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

KNOWRESU

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7.465	21	0.355	0.645	0.872
POTENT	1.247	4	0.312	0.566	0.688
HOURS	0.306	5	0.061	0.111	0.990
GHOURS	1.356	4	0.339	0.615	0.653
MSTAT	0.361	1	0.361	0.656	0.420
PRIOROCC	3.793	7	0.542	0.983	0.449
EXPLAINED	7.465	21	0.355	0.645	0.872
RESIDUAL	44.088	80	0.551		
TOTAL	51.553	101	0.510		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

MOTIVATE

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7.771	21	0.370	0.990	0.485
POTENT	1.994	4	0.498	1.333	0.265
HOURS	0.791	5	0.158	0.423	0.831
GHOURS	1.881	4	0.470	1.258	0.293
MSTAT	0.459	1	0.459	1.227	0.271
PRIOROCC	3.209	7	0.458	1.226	0.298
EXPLAINED	7.771	21	0.370	0.990	0.485
RESIDUAL	29.907	80	0.374		
TOTAL	37.678	101	0.373		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

STDTECH

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	11.274	21	0.537	1.651	0.058
POTENT	0.840	4	0.210	0.646	0.631
HOURS	3.123	5	0.625	1.921	0.100
GHOURS	1.487	4	0.372	1.143	0.342
MSTAT	0.328	1	0.328	1.010	0.318
PRIOROCC	6.686	7	0.955	2.937	0.009
EXPLAINED	11.274	21	0.537	1.651	0.058
RESIDUAL	26.013	80	0.325		
TOTAL	37.287	101	0.369		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

COMMUNIC

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	17.184	21	0.818	0.947	0.535
POTENT	2.150	4	0.537	0.622	0.648
HOURS	6.107	5	1.221	1.413	0.228
GHOURS	2.429	4	0.607	0.702	0.593
MSTAT	0.176	1	0.176	0.203	0.653
PRIOROCC	8.827	7	1.261	1.459	0.194
EXPLAINED	17.184	21	0.818	0.947	0.535
RESIDUAL	69.145	80	0.864		
TOTAL	86.329	101	0.855		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

*** A N A L Y S I S   O F   V A R I A N C E ***

CARRINST

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	16.899	21	0.805	1.181	0.290
POTENT	4.398	4	1.100	1.614	0.179
HOURS	5.239	5	1.048	1.538	0.187
GHOURS	2.485	4	0.621	0.912	0.461
MSTAT	0.317	1	0.317	0.465	0.497
PRIOROCC	7.368	7	1.053	1.545	0.164
EXPLAINED	16.899	21	0.805	1.181	0.290
RESIDUAL	54.486	80	0.681		
TOTAL	71.385	101	0.707		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

*** A N A L Y S I S   O F   V A R I A N C E ***

ENTHUS

BY POTENT
HOURS
GHOURS
MSTAT
PRIOROCC

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	9.675	21	0.461	0.966	0.512
POTENT	1.154	4	0.289	0.605	0.660
HOURS	2.940	5	0.588	1.233	0.301
GHOURS	2.919	4	0.730	1.531	0.201
MSTAT	0.635	1	0.635	1.331	0.252
PRIOROCC	3.719	7	0.531	1.114	0.362
EXPLAINED	9.675	21	0.461	0.966	0.512
RESIDUAL	38.138	80	0.477		
TOTAL	47.814	101	0.473		

105 CASES WERE PROCESSED.
3 CASES (2.9 PCT) WERE MISSING.

Appendix E: Relative Contribution Of AGE2 And IDA In The Prediction Of Some Primary Variables

* * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data
Equation Number 1   Dependent Variable..   ALLMOT
Beginning Block Number 1. Method: Enter   IDA   AGE2

Variable(s) Entered on Step Number 1..   AGE2
                                    2..   IDA

Analysis of Variance

	Sum of Squares	DF	Mean Square
Regression	5.70939	2	2.85469
Residual	23.76335	87	.27314

F =   10.45132   Signif F = .0001

Multiple R	.44013	Standard Error	.52263
R Square	.19372	Adjusted R Square	.17518

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
AGE2	-.098464	.041790	-.228213	-2.356	.0207
IDA	.151515	.041685	.352054	3.635	.0005
(Constant)	-1.981228	1.908573		-1.038	.3021

End Block Number 1 All requested variables entered.

* * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Equation Number 2   Dependent Variable..   COMMUNIC
Beginning Block Number 1. Method: Enter   IDA   AGE2

Variable(s) Entered on Step Number 1..   AGE2
                                    2..   IDA

Analysis of Variance

	Sum of Squares	DF	Mean Square
Regression	5.03966	2	2.51983
Residual	73.53295	87	.84521

F =   2.98132   Signif F = .0559

Multiple R	.25326	Standard Error	.91935
R Square	.06414	Adjusted R Square	.04263

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
AGE2	-.150987	.073512	-.214325	-2.054	.0430
IDA	-.112836	.073327	-.160574	-1.539	.1275
(Constant)	10.217994	3.357345		3.043	.0031

* * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Equation Number 3   Dependent Variable..   KNOWRESU
Beginning Block Number 1. Method: Enter   IDA   AGE2

Variable(s) Entered on Step Number 1..   AGE2
2..   IDA

Analysis of Variance

	Sum of Squares	DF	Mean Square
Regression	5.43329	2	2.71665
Residual	41.55160	87	.47760

F =   5.68807   Signif F = .0048

Multiple R	.34006	Standard Error	.69109
R Square	.11564		

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
AGE2	-.136482	.055260	-.250534	-2.470	.0155
IDA	.110852	.055121	.204000	2.011	.0474
(Constant)	-.093945	2.523765		-.037	.9704

End Block Number 1 All requested variables entered.

* * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Equation Number 4   Dependent Variable..   HARDGOAL
Beginning Block Number 1. Method: Enter   IDA   AGE2

Variable(s) Entered on Step Number 1..   AGE2
2..   IDA

Analysis of Variance

	Sum of Squares	DF	Mean Square
Regressicn	3.64319	2	1.82160
Residual	47.03806	87	.54067

F =   3.36916   Signif F = .0390

Multiple R	.26811	Standard Error	.73530
R Square	.07188	Adjusted R Square	.05055

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
AGE2	-.042860	.058795	-.075754	-.729	.4680
IDA	.140516	.058647	.248982	2.396	.0187
(Constant)	-2.219359	2.685219		-.827	.4108

End Block Number 1 All requested variables entered.

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 5 Dependent Variable.. MOTIVATE

Beginning Block Number 1. Method: Enter IDA AGE2
Variable(s) Entered on Step Number 1.. AGE2
2.. IDA

Analysis of Variance

	Sum of Squares	DF	Mean Square
Regression	6.26979	2	3.13489
Residual	28.30706	87	.32537

F = 9.63490 Signif F = .0002

Multiple R	.42583	Standard Error	.57041
R Square	.18133	Adjusted R Square	.16251

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
AGE2	-.074166	.045611	-.158701	-1.626	.1076
IDA	.176233	.045496	.378060	3.874	.0002
(Constant)	-3.785921	2.083063		-1.817	.0726

End Block Number 1 All requested variables entered.

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 6 Dependent Variable.. CLEARGOL
Beginning Block Number 1. Method: Enter IDA AGE2

Variable(s) Entered on Step Number 1.. AGE2
2.. IDA

Analysis of Variance

	Sum of Squares	DF	Mean Square
Regression	3.83719	2	1.91859
Residual	43.86854	87	.50424

F = 3.80495 Signif F = .0261

Multiple R	.28361	Standard Error	.71010
R Square	.08043	Adjusted R Square	.05930

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
AGE2	-.105278	.056780	-.191789	-1.854	.0671
IDA	.103417	.056637	.188875	1.826	.0713
(Constant)	.055807	2.593173		.022	.9829

End Block Number 1 All requested variables entered.

Appendix F: Stepwise Regression Analysis Of FLYAPT

* * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Listwise Deletion of Missing Data
Equation Number 1   Dependent Variable..   FLYAPT
Beginning Block Number 1. Method: Stepwise

Variable(s) Entered on Step Number
1..   GLIDER

Multiple R	.22335
R Square	.04989
Adjusted R Square	.04039
Standard Error	3.58335

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	67.41951	67.41951
Residual	100	1284.04128	12.84041

F =   5.25057   Signif F = .0240

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
GLIDER	.039186	.017101	.223353	2.291	.0240
(Constant)	26.284879	.369297		71.175	.0000

------------- Variables not in the Equation -------------

Variable	Beta In	Partial	Min Toler	T	Sig T
STDTECH	-.120783	-.123856	.999079	-1.242	.2172
CAREINST	-.023316	-.023919	.999933	-.238	.8123
COMMUNIC	-.012690	-.012985	.994763	-.129	.8975
KNOWRESU	-.042228	-.043029	.986479	-.429	.6692
ENTHUS	-.034422	-.034951	.979545	-.348	.7286
HARDGOAL	-.137072	-.139718	.987136	-1.404	.1635
MOTIVATE	-.045177	-.046231	.994979	-.460	.6462
CLEARGOL	-.021915	-.022448	.996889	-.223	.8237
ACFT	.197154	.201992	.997320	2.052	.0428

****** M U L T I P L E   R E G R E S S I O N ******

Equation Number 1   Dependent Variable..   FLYAPT

Variable(s) Entered on Step Number
2..   ACPT

Multiple R	.29774
R Square	.08865
Adjusted R Square	.07024
Standard Error	3.52717

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	119.80942	59.90471
Residual	99	1231.65137	12.44092

F =   4.81513   Signif F = .0101

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
GLIDER	.037395	.016856	.213146	2.219	.0288
ACPT	.003017	.001470	.197154	2.052	.0428
(Constant)	26.090437	.375653		69.454	.0000

------------- Variables not in the Equation -------------

Variable	Beta In	Partial	Min Toler	T	Sig T
STDTECH	-.105398	-.109986	.990667	-1.095	.2760
CAREINST	.006962	.007207	.973989	.071	.9433
COMMUNIC	-.016736	-.017481	.992259	-.173	.8629
KNOWRESU	-.042360	-.044072	.983878	-.437	.6633
ENTHUS	-.015734	-.016238	.970769	-.161	.8726
HARDGOAL	-.117723	-.121854	.976443	-1.215	.2272
MOTIVATE	-.023407	-.024305	.982549	-.241	.8103
CLEARGOL	-.034515	-.036026	.992908	-.357	.7220

End Block Number   1   PIN =   .050 Limits reached.

Appendix G: Relationship Of Primary Variables To Performance

For No 143 Pilot's Course

N of Cases = 13

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. TSCORE
Beginning Block Number 1. Method: Enter

Variable(s) Entered on Step Number
1.. MOTIVATE
2.. HARDGOAL
3.. ENTHUS
4.. COMMUNIC
5.. KNOWRESU
6.. STDTECH
7.. CLEARGOL
8.. CAREINST

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	8	371.92730	46.49091
Residual	4	296.38039	74.09510

Multiple R	.74600	Standard Error	8.60785
R Square	.55652	Adjusted R Square	-.33044

F = .62745 Signif F = .7339

Condition number bounds: 15.492, 465.187

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. TSCORE

Variable	B	SE B	Beta	SE Beta	T	Sig T
MOTIVATE	-22.45	19.09	-1.54	1.31	-1.176	.3047
HARDGOAL	4.59	7.48	.35	.57	.614	.5727
ENTHUS	-3.59	9.79	-.39	1.08	-.367	.7322
COMMUNIC	-.55	6.21	-.06	.65	-.088	.9339
KNOWRESU	9.67	7.91	.68	.56	1.222	.2886
STDTECH	9.79	13.63	.65	.91	.718	.5123
CLEARGOL	15.45	17.70	.67	.77	.873	.4320
CAREINST	-3.10	15.07	-.22	1.05	-.206	.8472
(Constant)	-9.88	66.56				

End Block Number 1 All requested variables entered.

For No 144 Pilot's Course

N of Cases = 18

* * * * M U L T I P L E R E G R E S S I O N * * * *

Listwise Deletion of Missing Data
Selecting only Cases for which IDA EQ 44

Equation Number 1 Dependent Variable.. TSCORE
Beginning Block Number 1. Method: Enter

Variable(s) Entered on Step Number
1.. MOTIVATE
2.. COMMUNIC
3.. HARDGOAL
4.. CAREINST
5.. ENTHUS
6.. CLEARGOL
7.. STDTECH
8.. KNOWRESU

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	8	509.54865	63.69358
Residual	9	1586.22913	176.24768

Multiple R	.49308	Standard Error	13.27583
R Square	.24313	Adjusted R Square	-.42964

F = .36139 Signif F = .9167

Condition number bounds: 5.663, 211.355

-------------- Variables in the Equation --------------

Variable	B	SE B	Beta	SE Beta	T	Sig T
MOTIVATE	-4.44	9.05	-.25	.51	-.490	.6355
COMMUNIC	-.10	4.99	-.01	.46	-.019	.9851
HARDGOAL	-5.51	6.18	-.43	.48	-.891	.3963
CAREINST	.21	4.12	.02	.47	.051	.9602
ENTHUS	4.63	6.45	.33	.46	.719	.4904
CLEARGOL	4.95	7.57	.36	.56	.654	.5292
STDTECH	7.85	9.59	.45	.55	.818	.4344
KNOWRESU	-7.58	9.48	-.55	.69	-.799	.4450
(Constant)	26.25	27.12				

End Block Number 1 All requested variables entered.

For No 146 Pilot' Course

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable STDTECH
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1.2687	3	.4229	1.1188	.3676
WITHIN GROUPS	6.8040	18	.3780		
TOTAL	8.0727	21			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable CAREINST
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.9008	3	.3003	.3955	.7578
WITHIN GROUPS	13.6648	18	.7592		
TOTAL	14.5657	21			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable COMMUNIC
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	4.8323	3	1.6108	1.9980	.1504
WITHIN GROUPS	14.5115	18	.8062		
TOTAL	19.3438	21			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable ENTHUS
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.6019	3	.2006	.7157	.5554
WITHIN GROUPS	5.0458	18	.2803		
TOTAL	5.6477	21			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable KNOWRESU
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1.4048	3	.4683	.7477	.5377
WITHIN GROUPS	11.2733	18	.6263		
TOTAL	12.6782	21			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable HARDGOAL
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1.4712	3	.4904	1.3171	.2997
WITHIN GROUPS	6.7021	18	.3723		
TOTAL	8.1733	21			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable MOTIVATE
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.3304	3	.1101	.3394	.7971
WITHIN GROUPS	5.8407	18	.3245		
TOTAL	6.1712	21			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable CLEARGOL
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1.5508	3	.5169	1.1311	.3630
WITHIN GROUPS	8.2265	18	.4570		
TOTAL	9.7774	21			

For No 147 Pilot's Course

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable STDTECH
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.0083	1	.0083	.0258	.8738
WITHIN GROUPS	8.0480	25	.3219		
TOTAL	8.0563	26			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable CAREINST
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.2074	1	.2074	.3223	.5753
WITHIN GROUPS	16.0889	25	.6436		
TOTAL	16.2963	26			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable COMMUNIC
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.1588	1	.1588	.1688	.6846
WITHIN GROUPS	23.5125	25	.9405		
TOTAL	23.6713	26			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable ENTHUS
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.2625	1	.2625	.5591	.4616
WITHIN GROUPS	11.7375	25	.4695		
TOTAL	12.0000	26			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable KNOWRESU
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.1418	1	.1418	.5433	.4679
WITHIN GROUPS	6.5245	25	.2610		
TOTAL	6.6663	26			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable HARDGOAL
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	1.8741	1	1.8741	2.4370	.1311
WITHIN GROUPS	19.2252	25	.7690		
TOTAL	21.0993	26			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable MOTIVATE
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.0578	1	.0578	.3715	.5477
WITHIN GROUPS	3.8883	25	.1555		
TOTAL	3.9460	26			

- - - - - - - - - - - O N E W A Y - - - - - - - - - - -

Variable CLEARGOL
By Variable RESULT

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARES	F RATIO	F PROB.
BETWEEN GROUPS	.0205	1	.0205	.0832	.7754
WITHIN GROUPS	6.1700	25	.2468		
TOTAL	6.1905	26			

Appendix H: Prediction Of Performance

For No 144 Pilots' Course

****** M U L T I P L E   R E G R E S S I O N ******

Listwise Deletion of Missing Data
Selecting only Cases for which IDA EQ 44
Equation Number 1 Dependent Variable.. TSCORE

Beginning Block Number 1. Method: Enter
Variable(s) Entered on Step Number 1.. ACFT
2.. GLIDER
3.. COMMUNIC
4.. FLYAPT
5.. HARDGOAL
6.. CLEARGOL
7.. CAREINST
8.. ENTHUS
9.. MOTIVATE
10.. STDTECH
11.. KNOWRESU

Analysis of Variance

	Sum of Squares	DF	Mean Square
Regression	1228.38502	11	111.67137
Residual	867.39275	6	144.56546

F = .77246 Signif F = .6643

Multiple R	.76559	Standard Error	12.02354
R Square	.58612	Adjusted R Square	-.17265

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
ACFT	.068529	.046497	.930456	1.474	.1910
GLIDER	.121865	.109981	.436803	1.108	.3103
COMMUNIC	2.535556	5.846784	.234983	.434	.6797
FLYAPT	-3.333832	1.975146	-.956303	-1.688	.1424
HARDGOAL	-15.068888	7.768389	-1.165214	-1.940	.1005
CLEARGOL	8.861152	8.018996	.651493	1.105	.3115
CAREINST	-.221749	5.369148	-.025216	-.041	.9684
ENTHUS	11.313903	6.950741	.805572	1.628	.1547
MOTIVATE	12.521829	11.643053	.712621	1.075	.3235
STDTECH	14.730660	11.856899	.839081	1.242	.2605
KNOWRESU	-28.483887	13.233928	-2.071494	-2.152	.0749
(Constant)	78.746568	78.655537		1.001	.3554

End Block Number 1 All requested variables entered.

For No 144 Pilots' Course

```
                **** M U L T I P L E   R E G R E S S I O N ****

Listwise Deletion of Missing Data
   Selecting only Cases for which       IDA EQ 44
 Equation Number 1    Dependent Variable..   TSCORE

 Beginning Block Number  1.  Method:  Enter

 Variable(s) Entered on Step Number   1..     ACFT
                                      2..     GLIDER
                                      3..     COMMUNIC
                                      4..     PRIOROCC
                                      5..     AGE2
                                      6..     CLEARGOL
                                      7..     HARDGOAL
                                      8..     CAREINST
                                      9..     FLYAPT
                                     10..     ENTHUS
                                     11..     MOTIVATE
                                     12..     STDTECH
                                     13..     KNOWRESU

Analysis of Variance
                        Sum of Squares     DF       Mean Square
Regression                  1611.54198     13         123.96477
Residual                     484.23579      4         121.05895

                       F =       1.02400      Signif F =  .5465

Multiple R       .87690          Standard Error       11.00268
R Square         .76895          Adjusted R Square      .01802

 ------------------ Variables in the Equation ------------------
```

Variable	B	SE B	Beta	T	Sig T
ACFT	.103527	.047578	1.405639	2.176	.0952
GLIDER	.006229	.122697	.022327	.051	.9619
COMMUNIC	-6.984427	7.633687	-.647283	-.915	.4120
PRIOROCC	2.820865	1.985421	.559676	1.421	.2284
AGE2	-6.838064	4.353537	-.882978	-1.571	.1913
CLEARGOL	8.584235	7.417292	.631133	1.157	.3115
HARDGOAL	-16.139185	7.152429	-1.247976	-2.256	.0870
CAREINST	7.762618	6.764433	.882719	1.148	.3151
FLYAPT	-.881373	2.372255	-.252820	-.372	.7291
ENTHUS	18.275944	8.797193	1.301283	2.077	.1063
MOTIVATE	-4.624748	14.422469	-.263196	-.321	.7645
STDTECH	35.339306	15.875190	2.012982	2.226	.0900
KNOWRESU	-28.866215	12.447241	-2.099299	-2.319	.0812
(Constant)	-25.343863	94.591093		-.268	.8020

For No 146 Pilot' Course

* * * A N A L Y S I S   O F   V A R I A N C E * * *

ACFT
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	10815.373	3	3605.124	1.615	0.221
RESIDUAL	40171.400	18	2231.744		
TOTAL	50986.773	21	2427.942		

22 CASES WERE PROCESSED.
0 CASES (0. PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

GLIDER
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	25.880	3	8.627	0.243	0.865
RESIDUAL	638.483	18	35.471		
TOTAL	664.364	21	31.636		

22 CASES WERE PROCESSED.
0 CASES (0. PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

PRIOROCC
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	0.839	3	0.280	0.081	0.970
RESIDUAL	62.433	18	3.469		
TOTAL	63.273	21	3.013		

22 CASES WERE PROCESSED.
0 CASES (0. PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

FLYAPT
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	37.271	3	12.424	1.117	0.368
RESIDUAL	200.183	18	11.121		
TOTAL	237.455	21	11.307		

22 CASES WERE PROCESSED.
0 CASES (0. PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

AGE2
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	11.339	3	3.780	2.480	0.094
RESIDUAL	27.433	18	1.524		
TOTAL	38.773	21	1.846		

22 CASES WERE PROCESSED.
0 CASES (0. PCT) WERE MISSING.

For No 147 Pilot's Course

* * * A N A L Y S I S   O F   V A R I A N C E * * *

ACFT
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	101422.183	1	101422.183	0.564	0.460
RESIDUAL	4139046.857	23	179958.559		
TOTAL	4240469.040	24	176686.210		

27 CASES WERE PROCESSED.
2 CASES (7.4 PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

GLIDER
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	385.525	1	385.525	1.077	0.310
RESIDUAL	8234.635	23	358.028		
TOTAL	8620.160	24	359.173		

27 CASES WERE PROCESSED.
2 CASES (7.4 PCT) WERE MISSING.

* * * A N A L Y S I S   O F   V A R I A N C E * * *

PRIOROCC
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	3.500	1	3.500	0.679	0.418
RESIDUAL	118.500	23	5.152		
TOTAL	122.000	24	5.083		

27 CASES WERE PROCESSED.
2 CASES (7.4 PCT) WERE MISSING.

*** ANALYSIS OF VARIANCE ***

FLYAPT
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	19.841	1	19.841	1.782	0.195
RESIDUAL	256.159	23	11.137		
TOTAL	276.000	24	11.500		

27 CASES WERE PROCESSED.
2 CASES (7.4 PCT) WERE MISSING.

*** ANALYSIS OF VARIANCE ***

AGE2
BY RESULT

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
RESULT	0.115	1	0.115	0.061	0.807
RESIDUAL	43.325	23	1.884		
TOTAL	43.440	24	1.810		

27 CASES WERE PROCESSED.
2 CASES (7.4 PCT) WERE MISSING.

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VITA

Wing Commander Terence W. Connolly was born on [redacted] He graduated from high school in Ashfield, Sydney, in December 1968 and commenced training at the Royal Australian Air Force Academy, Point Cook, in January 1969. After graduating from the Academy in December 1972, he was trained as a pilot at No 1 and No 2 Flying Training Schools. He worked as a transport pilot in Nos 35 and 38 Squadrons after gaining his wings in March 1974. Subsequent to training as a flying instructor in 1977, he has served at both flying training schools. He was serving as chief instructor at the School of Air Force Studies, RAAF College, prior to entering the School of Systems and Logistics, Air Force Institute of Technology, in June 1987.

[redacted]

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

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OMB No. 0704-0188

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8a. NAME OF FUNDING / SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
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See Block 19

12. PERSONAL AUTHOR(S)
Terence W. Connolly, B.S., Wing Commander, RAAF

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16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Pilots, Flight Training, Learning Motivation Training
05	08		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Title: THE INFLUENCE OF INDIVIDUAL DIFFERENCES IN LEARNING AND MOTIVATION ON THE PERFORMANCE OF STUDENTS IN RAAF PILOTS' COURSE

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This study had two objectives:

1. to develop a valid instrument to measure the learning and motivation of students in pilot training for the Royal Australian Air Force; and

2. to test the hypothesis that students of a certain ability level would achieve a level of performance dependent on their learning experiences and their motivation.

A survey of all students on course was conducted in late March - early April 1988. Scales were developed to measure variables related to the quality of instruction and the level of motivation reported by the students. The scales appeared to validly discriminate among students on a basis of age and position in the training pipeline.

Aptitude test scores and relevant biographical data (e.g., number of hours in powered aircraft prior to the course) were collected to provide an independent measure of ability. Finally, a measure of performance was collected for as many students as possible. The hypothesis was tested by investigating the nature of relationships between the predictor variables and the performance measure. Unfortunately, the hypothesis was not proved.

Although this research did not explicitly specify the relationships between ability, instruction, motivation, and performance, it did indicate the potential of some variables to explain part of the variance in student performance in pilot training. Directions for future research were recommended.